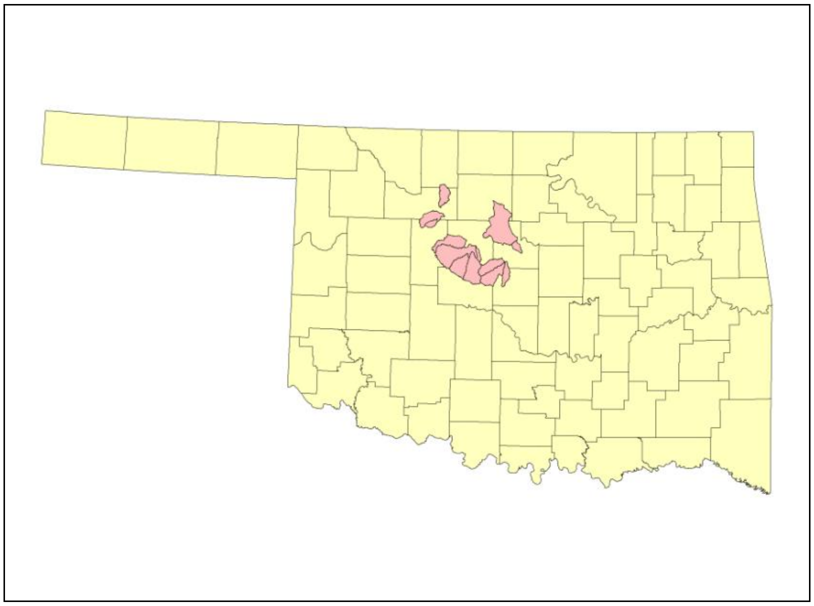
FINAL

BACTERIA TOTAL MAXIMUM DAILY LOADS FOR THE LOWER CIMARRON RIVER-SKELETON CREEK AREA (OK620910)



Prepared by:

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

SEPTEMBER 2009

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OKWBID

OK620910010010_00, OK620910020040_00, OK620910020250_00,
OK620910020270_00, OK620910020310_00, OK620910030010_00,
OK620910040010_20, OK620910040120_00, OK620910040100_00,
OK620910050010_00, OK620910050020_00, OK620910050030_00,
OK620910050080_00

Prepared by:

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SEPTEMBER 2009

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ACRONYMS AND ABBREVIATIONS

ASAE	American Society of Agricultural Engineers
BMP	best management practice
CAFO	Concentrated Animal Feeding Operation
CFR	Code of Federal Regulations
cfs	Cubic feet per second
cfu	Colony-forming unit
CPP	Continuing planning process
CWA	Clean Water Act
DMR	Discharge monitoring report
LA	Load allocation
LDC	Load duration curve
mg	Million gallons
mgd	Million gallons per day
mL	Milliliter
MOS	Margin of safety
MS4	Municipal separate storm sewer system
NPDES	National Pollutant Discharge Elimination System
O.S.	Oklahoma statutes
ODAFF	Oklahoma Department of Agriculture, Food and Forestry
ODEQ	Oklahoma Department of Environmental Quality
OPDES	Oklahoma Pollutant Discharge Elimination System
OSWD	Onsite wastewater disposal
OWRB	Oklahoma Water Resources Board
PBCR	Primary body contact recreation
PRG	Percent reduction goal
SSO	Sanitary sewer overflow
TMDL	Total maximum daily load
USDA	U.S. Department of Agriculture
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
WLA	Wasteload allocation
WQM	Water quality monitoring
WQS	Water quality standard
WWTP	Wastewater treatment plant

Executive Summary

This report documents the data and assessment used to establish TMDLs for the pathogen indicator bacteria fecal coliform, *Escherichia coli (E. coli),* or Enterococci for certain waterbodies in the Lower Cimarron River-Skeleton Creek area. Elevated levels of pathogen indicator bacteria in aquatic environments indicate that a receiving water is contaminated with human or animal feces and that there is a potential health risk for individuals exposed to the water. Data assessment and TMDL calculations are conducted in accordance with requirements of Section 303(d) of the Clean Water Act (CWA), Water Quality Planning and Management Regulations (40 CFR Part 130), U.S. Environmental Protection Agency (USEPA) guidance, and Oklahoma Department of Environmental Quality (ODEQ) guidance and procedures. ODEQ is required to submit all TMDLs to USEPA for review and approval. Once the USEPA approves a TMDL, then the waterbody may be moved to Category 4a of a state's Integrated Water Quality Monitoring and Assessment Report, where it remains until compliance with water quality standards (WQS) is achieved (USEPA 2003).

The purpose of this report is to establish pollutant load allocations for indicator bacteria in impaired waterbodies, which is the first step toward restoring water quality and protecting public health. TMDLs determine the pollutant loading a waterbody can assimilate without exceeding the WQS for that pollutant. A TMDL consists of a wasteload allocation (WLA), load allocation (LA), and a margin of safety (MOS). The WLA is the fraction of the total pollutant load apportioned to point sources, and includes stormwater discharges regulated under the National Pollutant Discharge Elimination System (NPDES) as point sources. The LA is the fraction of the total pollutant load apportioned to nonpoint sources. The MOS is a percentage of the TMDL set aside to account for the lack of knowledge associated with natural process in aquatic systems, model assumptions, and data limitations.

This report does not stipulate specific control actions (regulatory controls) or management measures (voluntary best management practices) necessary to reduce bacteria loadings within each watershed. Watershed-specific control actions and management measures will be identified, selected, and implemented under a separate process.

E.1 Problem Identification and Water Quality Target

A decision was made to place specific waterbodies in this Study Area, listed in Table ES-1, on the ODEQ 2008 303(d) list because evidence of nonsupport of primary body contact recreation (PBCR) was observed.

Elevated levels of bacteria above the WQS for one or more of the bacterial indicators result in the requirement that a TMDL be developed. The TMDLs established in this report are a necessary step in the process to develop the bacteria loading controls needed to restore the primary body contact recreation use designated for each waterbody.

Table ES-1 Excerpt from the 2008 Integrated Report – Comprehensive Waterbody Assessment Category List

Waterbody ID	Waterbody Name	Stream Miles	Category	TMDL Date	Primary Body Contact Recreation
OK620910010010_00	Cimarron River	8.33	5	2019	N
OK620910020040_00	Cooper Creek	40.27	5	2016	N
OK620910020250_00	Deep Creek	25.42	5	2019	N
OK620910020270_00	Elm Creek	14.15	5	2019	N
OK620910020310_00	Indian Creek	16.71	5	2019	N
OK620910030010_00	Skeleton Creek	32.84	5	2019	N
OK620910040010_20	Cottonwood Creek	24.39	5	2010	N
OK620910040100_00	Chisholm Creek	21.15	5	2010	N
OK620910040120_00	Deer Creek	12.67	5	2010	N
OK620910050010_00	Kingfisher Creek	47.37	5	2019	N
OK620910050020_00	Trail Creek	14.87	5	2019	N
OK620910050030_00	Uncle Johns Creek	27.49	5	2019	N
OK620910050080_00	Dead Indian Creek	24.23	5	2019	N

N = Not Supporting; Source: 2008 Integrated Report, ODEQ 2008.

For the data collected between 2000 and 2007 and the re-assessment for PBCR use conducted for this study, evidence of nonsupport of the PBCR use based only on fecal coliform concentrations was observed in four waterbodies: Elm Creek (OK620910020270_00), Cottonwood Creek (OK620910040010_20), Deer Creek (OK620910040120_00), and Trail Creek (OK620910050020_00). Evidence of nonsupport of the PBCR use based only on Enterococci concentrations was observed in one waterbody: Cimarron River (OK620910010010_00). Evidence of nonsupport of the PBCR use based on both *E. coli* and Enterococci was observed in five waterbodies: Cooper Creek (OK620910020040_00), Deep Creek (OK620910020250_00), Indian Creek (OK620910020310_00), Uncle Johns Creek (OK620910050030_00) and Dead Indian Creek (OK620910050080_00). Lastly, evidence of nonsupport for all three bacteria indicators was observed in Skeleton Creek (OK620910030010_00) and Kingfisher Creek (OK620910050010_00). Table ES-2 summarizes the waterbodies requiring TMDLs for not supporting PBCR as a result of the data re-assessment by this study.

Table ES-2 Waterbodies Requiring TMDLs for Not Supporting Primary Contact Recreation Use Based on Data Re-assessment by this Study

WQM Station	Waterbody ID	Waterbody Name	Indicator Bacteria		
			FC	*E. coli*	ENT
OK620910010010-001AT	OK620910010010_00	Cimarron River			X
OK620910-02-0040C	OK620910020040_00	Cooper Creek		X	X
OK620910-02-0250C	OK620910020250_00	Deep Creek		X	X
OK620910-02-0270G	OK620910020270_00	Elm Creek	X		
OK620910-02-0310C	OK620910020310_00	Indian Creek		X	X
OK620910030010-001AT OK620910-03-0010F OK620910-03-0010S	OK620910030010_00	Skeleton Creek	X	X	X
OK620910-04-0010G	OK620910040010_20	Cottonwood Creek	X		
OK620910-04-0100G	OK620910040100_00	Chisholm Creek			
OK620910-04-0120B	OK620910040120_00	Deer Creek	X		
OK620910-05-0010G OK620910-05-0010J	OK620910050010_00	Kingfisher Creek	X	X	X
OK620910-05-0020G	OK620910050020_00	Trail Creek	X		
OK620910-05-0030C	OK620910050030_00	Uncle Johns Creek		X	X
OK620910-05-0080D	OK620910050080_00	Dead Indian Creek		X	X

ENT = Enterococci; FC = fecal coliform

Table ES-2 represents the result of updated assessment of the attainment status for the indicator bacteria in these waterbodies. Assessment conducted for this TMDL study was based on latest data and the updated Oklahoma WQS. In most cases, this new assessment is different from that in the Oklahoma 2008 303(d) list for these waterbodies. For example, Chisholm Creek was listed as impaired for PBCR in the 303(d) list due to high Enterococci counts. New assessment showed that Chisholm Creek did not exceed the criteria for any of the three indicator bacteria. As a result, Chisholm Creek does not need a TMDL.

The definition of PBCR is summarized by the following excerpt from Chapter 45 of the Oklahoma WQSs (OWRB 2008a).

(a) Primary Body Contact Recreation involves direct body contact with the water where a possibility of ingestion exists. In these cases the water shall not contain chemical,

physical or biological substances in concentrations that are irritating to skin or sense organs or are toxic or cause illness upon ingestion by human beings.

(b) In waters designated for Primary Body Contact Recreation...limits...shall apply only during the recreation period of May 1 to September 30. The criteria for Secondary Body Contact Recreation will apply during the remainder of the year.

To implement Oklahoma's WQS for PBCR, the Oklahoma Water Resources Board (OWRB) promulgated Chapter 46, *Implementation of Oklahoma's Water Quality Standards* (OWRB 2008b). The excerpt below from Chapter 46: 785:46-15-6, stipulates how water quality data will be assessed to determine support of the PBCR use as well as how the water quality target for TMDLs will be defined for each bacterial indicator.

(a) Scope. The provisions of this Section shall be used to determine whether the subcategory of Primary Body Contact of the beneficial use of Recreation designated in OAC 785:45 for a waterbody is supported during the recreation season from May 1 through September 30 each year. Where data exist for multiple bacterial indicators on the same waterbody or waterbody segment, the determination of use support shall be based upon the use and application of all applicable tests and data.

(b) Screening levels:

(1) The screening level for fecal coliform shall be a density of 400 colonies per 100ml.

(2) The screening level for Escherichia coli shall be a density of 235 colonies per 100 ml in streams designated in OAC 785:45 as Scenic Rivers and in lakes, and 406 colonies per 100 ml in all other waters of the state designated as Primary Body Contact Recreation.

(3) The screening level for Enterococci shall be a density of 61 colonies per 100 ml in streams designated in OAC 785:45 as Scenic Rivers and in lakes, and 108 colonies per 100 ml in all other waters of the state designated as Primary Body Contact Recreation.

(c) Fecal coliform:

(1) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be fully supported with respect to fecal coliform if the geometric mean of 400 colonies per 100 ml is met and no greater than 25% of the sample concentrations from that waterbody exceed the screening level prescribed in (b) of this Section.

(2) The parameter of fecal coliform is not susceptible to an assessment that Primary Body Contact Recreation is partially supported.

(3) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be not supported with respect to fecal coliform if the geometric mean of 400 colonies per 100 ml is not met, or greater than 25% of the sample concentrations from that waterbody exceed the screening level prescribed in (b) of this Section, or both such conditions exist.

(d) Escherichia coli (E. coli):

(1) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be fully supported with respect to E. coli if the geometric mean of 126 colonies

per 100 ml is met, or the sample concentrations from that waterbody taken during the recreation season do not exceed the screening level prescribed in (b) of this Section, or both such conditions exist.

(2) The parameter of E. coli is not susceptible to an assessment that Primary Body Contact Recreation is partially supported.

(3) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be not supported with respect to E. coli if the geometric mean of 126 colonies per 100 ml is not met and any of the sample concentrations from that waterbody taken during the recreation season exceed a screening level prescribed in (b) of this Section.

(e) Enterococci:

(1) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be fully supported with respect to Enterococci if the geometric mean of 33 colonies per 100 ml is met, or the sample concentrations from that waterbody taken during the recreation season do not exceed the screening level prescribed in (b) of this Section, or both such conditions exist.

(2) The parameter of Enterococci is not susceptible to an assessment that Primary Body Contact Recreation is partially supported.

(3) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be not supported with respect to Enterococci if the geometric mean of 33 colonies per 100 ml is not met and any of the sample concentrations from that waterbody taken during the recreation season exceed a screening level prescribed in (b) of this Section.

Compliance with the Oklahoma WQS is based on meeting requirements for all three bacterial indicators. Where concurrent data exist for multiple bacterial indicators on the same waterbody or waterbody segment, each indicator group must demonstrate compliance with the numeric criteria prescribed (OWRB 2008a).

As stipulated in the WQS, utilization of the geometric mean to determine compliance for any of the three indicator bacteria depends on the collection of five samples within a 30-day period. For most waterbodies in Oklahoma there are insufficient data available to calculate the 30-day geometric mean since most water quality samples are collected once a month. As a result, waterbodies placed on the 303(d) list for not supporting the PBCR are the result of individual samples exceeding the instantaneous criteria or the long-term geometric mean of individual samples exceeding the geometric mean criteria for each respective bacterial indicator. Targeting the instantaneous criterion established for the primary contact recreation season (May 1st to September 30th) as the water quality goal for TMDLs corresponds to the basis for 303(d) listing and may be protective of the geometric mean criterion as well as the criteria for the secondary contact recreation season. However, both the instantaneous and geometric mean criteria for *E. coli* and Enterococci will be evaluated as water quality targets to ensure the most protective goal is established for each waterbody.

All TMDLs for fecal coliform must take into account that no more than 25 percent of the samples may exceed the instantaneous numeric criteria. For *E. coli* and Enterococci, no samples may exceed instantaneous criteria. Since the attainability of stream beneficial uses for *E. coli* and Enterococci is based on the compliance of either the instantaneous or a long-term geometric mean criterion, percent reductions goals will be calculated for both criteria. TMDLs will be based on the percent reduction required to meet either the instantaneous or the long-term geometric mean criterion, whichever is less.

E.2 Pollutant Source Assessment

A source assessment characterizes known and suspected sources of pollutant loading to impaired waterbodies. Sources within a watershed are categorized and quantified to the extent that information is available. Bacteria originate from warm-blooded animals and sources may be point or nonpoint in nature.

There are no NPDES-permitted facilities of any type in the contributing watersheds of Cimarron River (OK620910010010_00), Deep Creek, Elm Creek, Trail Creek, and Uncle Johns Creek. Seven of the 13 watersheds in the Study Area, including Indian Creek (OK620910020310_00), Skeleton Creek (OK620910030010_00), Cottonwood Creek (OK620910040010_20), Chisholm Creek (OK620910040100_00), Deer Creek (OK620910040120_00), Kingfisher Creek (OK620910050010_00), and Dead Indian Creek (OK620910050080_00) have one or more continuous point source discharger.

There are 12 recorded no-discharge facilities in the Study Area. For the purposes of these TMDLs, no-discharge facilities do not contribute bacteria loading to the listed waterbodies and their tributaries. However, it is possible the wastewater collection systems associated with WWTPs could be a source of bacteria loading. While not all sewer overflows are reported, ODEQ has some data on sanitary sewer overflows (SSO) available. There were 625 SSO occurrences, ranging from 0 gallon (negligible amount) to 4.5 million gallons, reported for certain watersheds within the Study Area between January 1997 and June 2009. The City of Oklahoma City, located partially in Deer Creek (OK620910040120_00), falls under requirements designated by USEPA for inclusion in the Phase I stormwater program. There is one NPDES-permitted concentrated animal feeding operation within the Study Area.

Since there are no NPDES-permitted facilities present in the Cimarron River (OK620910010010_00), Deep Creek, Elm Creek, Trail Creek, and Uncle Johns Creek watersheds, nonsupport of the PBCR use is caused entirely by nonpoint sources. In five of the other six watersheds, most point sources are relatively minor and for the most part tend to meet instream water quality criteria in their effluent, so nonpoint sources are considered to be the major origin of bacteria loading. Given the flow volume of the Oklahoma City Deer Creek facility and the municipal separate storm sewer system (MS4) area in the Deer Creek watershed, point source loading may be significant. Table 3-14 in Section 3 of this TMDL Report summarizes the suspected sources of bacteria loading in each impaired watershed.

Nonpoint source bacteria loading to the receiving streams of each waterbody may emanate from a number of different sources including wildlife, various agricultural activities and domesticated animals, land application fields, urban runoff, failing onsite wastewater disposal (OSWD) systems, and domestic pets. The data analysis and the load duration curves (LDC) demonstrate that exceedances in stream segments are the result of a variety of nonpoint source loading occurring during a range of flow conditions. Low flow exceedances are likely due to a combination of non-point sources, uncontrolled point sources and permit noncompliance.

E.3 Using Load Duration Curves to Develop TMDLs

The TMDL calculations presented in this report are derived from LDCs. LDCs facilitate rapid development of TMDLs and as a TMDL development tool, may assist in identifying whether impairments are associated with point or nonpoint sources.

Use of the LDC obviates the need to determine a design storm or selected flow recurrence interval with which to characterize the appropriate flow level for the assessment of critical conditions. For waterbodies impacted by both point and nonpoint sources, the "nonpoint source critical condition" would typically occur during high flows, when rainfall runoff would contribute the bulk of the pollutant load, while the "point source critical condition" would typically occur during low flows, when treatment plant effluents would dominate the base flow of the impaired water. However, flow range is only a general indicator of the relative proportion of point/nonpoint contributions. It is not used in this report to quantify point source or nonpoint source contributions. Violations that occur during low flows may not be caused exclusively by point sources. Violations have been noted in some watersheds that contain no point sources. Research has show that bacteria loading in streams during low flow conditions may be due to direct deposit of cattle manure into streams and faulty septic tank/lateral field systems.

The basic steps to generating an LDC involve:

- obtaining daily flow data for the site of interest from the U.S. Geological Survey ;
- sorting the flow data and calculating flow exceedance percentiles for the time period and season of interest;
- obtaining the water quality data from the primary contact recreation season (May 1 through September 30);
- matching the water quality observations with the flow data from the same date;
- display a curve on a plot that represents the allowable load determined by multiplying the actual or estimated flow by the WQS for each respective indicator;
- multiplying the flow by the water quality parameter concentration to calculate daily loads; then
- plotting the flow exceedance percentiles and daily load observations in a load duration plot.

LDCs display the maximum allowable load over the complete range of flow conditions by a line using the calculation of flow multiplied by the water quality criterion. The TMDL can be expressed as a continuous function of flow, equal to the line, or as a discrete value derived from a specific flow condition.

E.4 TMDL Calculations

As indicated above, the bacteria TMDLs for the 303(d)-listed waterbodies covered in this report were derived using LDCs. A TMDL is expressed as the sum of all WLAs (point source loads), LAs (nonpoint source loads), and an appropriate MOS, which attempts to account for lack of knowledge concerning the relationship between effluent limitations and water quality.

This definition can be expressed by the following equation:

$$\boldsymbol{TMDL = \Sigma\ WLA + \Sigma\ LA + MOS}$$

For each waterbody the TMDLs presented in this report are expressed as a percent reduction across the full range of flow conditions (See Table ES-3). The difference between existing loading and the water quality target is used to calculate the loading reductions required.

Table ES-3 presents the percent reductions necessary for each bacterial indicator causing nonsupport of the PBCR use in each waterbody of the Study Area. Selection of the appropriate PRG for each waterbody in Table ES-3 is denoted by bold text. For Fecal Coliform, the PRG is determined based on instantaneous criteria. For *E. coli* and Enterococci, the PRG will be the lesser of that required to meet the geometric mean or instantaneous criteria because WQSs are considered to be met if, 1) either the geometric mean of all data is less than the geometric mean criteria, or 2) no samples exceed the instantaneous criteria. No PRG is set for Chisholm Creek as new assessment of monitoring data found no bacteria impairment in the waterbody.

Table ES-3 TMDL Percent Reductions Required to Meet Water Quality Standards for Impaired Waterbodies in the Study Area

WQM Station	Waterbody ID	Waterbody Name	Percent Reduction Required				
			FC	EC		ENT	
			Instantaneous	Instantaneous	Geo-mean	Instantaneous	Geo-mean
OK620910010010-001AT	OK620910010010_00	Cimarron River				97%	**51%**
OK620910-02-0040C	OK620910020040_00	Cooper Creek		98%	**17%**	99%	**87%**
OK620910-02-0250C	OK620910020250_00	Deep Creek		83%	**48%**	95%	**86%**
OK620910-02-0270G	OK620910020270_00	Elm Creek	**40%**				
OK620910-02-0310C	OK620910020310_00	Indian Creek		48%	**22%**	89.4%	**88.9%**
OK620910030010-001AT OK620910-03-0010F OK620910-03-0010S	OK620910030010_00	Skeleton Creek	**49%**	97%	**27%**	99%	**90%**
OK620910-04-0010G	OK620910040010_20	Cottonwood Creek	**28%**				
OK620910-04-0100G	OK620910040100_00	Chisholm Creek					
OK620910-04-0120B	OK620910040120_00	Deer Creek	**72%**				
OK620910-05-0010G OK620910-05-0010J	OK620910050010_00	Kingfisher Creek	**40%**	82%	**58%**	95%	**93%**
OK620910-05-0020G	OK620910050020_00	Trail Creek	**55%**				
OK620910-05-0030C	OK620910050030_00	Uncle Johns Creek		82%	**34%**	97%	**94%**
OK620910-05-0080D	OK620910050080_00	Dead Indian Creek		97%	**73%**	99%	**95%**

The TMDL, WLA, LA, and MOS vary with flow condition, and are calculated at every 5^{th} flow interval percentile. For illustrative purposes, the TMDL, WLA, LA, and MOS are calculated for the median flow at each site in Table ES-4. The WLA component of each TMDL is the sum of all WLAs within the contributing watershed of each waterbody. The sum of the WLAs can be represented as a single line below the LDC. The WLA for MS4s is estimated based on the percentage of MS4 area which falls under the study watershed. The LDC and the simple equation of:

$$\textbf{\textit{Average LA = average TMDL – MOS - }}\sum \textbf{\textit{WLA}}$$

can provide an individual value for the LA in counts per day, which represents the area under the TMDL target line and above the WLA line. For MS4s the load reduction will be the same as the PRG established for the overall watershed. Where there are no continuous point sources the WLA is zero.

Table ES-4 TMDL Summaries Examples

Waterbody ID	WQM Station	Waterbody Name	Indicator Bacteria Species	TMDL† (cfu/day)	WLA_WWTP† (cfu/day)	WLA_MS4 (cfu/day)	LA† (cfu/day)	MOS† (cfu/day)
OK620910010010-001AT	OK620910010010_00	Cimarron River	ENT	1.06E+12	0.00E+00	0.00E+00	9.51E+11	1.06E+11
OK620910-02-0040C	OK620910020040_00	Cooper Creek	ENT	1.26E+10	0.00E+00	0.00E+00	1.14E+10	1.26E+09
OK620910-02-0250C	OK620910020250_00	Deep Creek	ENT	9.27E+09	0.00E+00	0.00E+00	8.34E+09	9.27E+08
OK620910-02-0270G	OK620910020270_00	Elm Creek	FC	1.02E+10	0.00E+00	0.00E+00	9.14E+09	1.02E+09
OK620910-02-0310C	OK620910020310_00	Indian Creek	ENT	7.99E+09	6.50E+07	0.00E+00	7.13E+09	7.99E+08
OK620910030010-001AT OK620910-03-0010F OK620910-03-0010S	OK620910030010_00	Skeleton Creek	ENT	4.76E+10	6.62E+07	0.00E+00	4.27E+10	4.76E+09
OK620910-04-0010G	OK620910040010_20	Cottonwood Creek	FC	1.71E+11	0.00E+00	0.00E+00	1.54E+11	1.71E+10
OK620910-04-0120B	OK620910040120_00	Deer Creek	FC	4.33E+11	1.14E+11	1.58E+10	2.61E+11	4.33E+10
OK620910-05-0010G OK620910-05-0010J	OK620910050010_00	Kingfisher Creek	ENT	6.95E+09	9.99E+08	0.00E+00	5.26E+09	6.95E+08
OK620910-05-0020G	OK620910050020_00	Trail Creek	FC	1.58E+09	0.00E+00	0.00E+00	1.42E+09	1.58E+08
OK620910-05-0030C	OK620910050030_00	Uncle Johns Creek	ENT	3.63E+09	0.00E+00	0.00E+00	3.27E+09	3.63E+08
OK620910-05-0080D	OK620910050080_00	Dead Indian Creek	ENT	2.71E+09	0.00E+00	0.00E+00	2.44E+09	2.71E+08

† Derived for illustrative purposes at the median flow value

Federal regulations (40 CFR §130.7(c)(1)) require that TMDLs include an MOS. The MOS is a conservative measure incorporated into the TMDL equation that accounts for the lack of knowledge associated with calculating the allowable pollutant loading to ensure WQSs are attained. USEPA guidance allows for use of implicit or explicit expressions of the MOS, or both. When conservative assumptions are used in development of the TMDL, or conservative factors are used in the calculations, the MOS is implicit. When a specific percentage of the TMDL is set aside to account for lack of knowledge, then the MOS is considered explicit.

For the explicit MOS the water quality target was set at 10 percent lower than the water quality criterion for each pathogen which equates to 360 colony-forming units per 100 milliliter (cfu/100 mL), 365.4 cfu/100 mL, and 97.2/100 mL for fecal coliform, *E. coli*, and Enterococci, respectively. The use of instream bacteria concentrations to estimate existing loading is another conservative element utilized in these TMDLs that can be recognized as an implicit MOS. This conservative approach to establishing the MOS will ensure that both the 30-day geometric mean and instantaneous bacteria standards can be achieved and maintained.

E.5 Reasonable Assurance

As authorized by Section 402 of the CWA, ODEQ has delegation of the NPDES in Oklahoma, except for certain jurisdictional areas related to agriculture and the oil and gas industry retained by the Oklahoma Department of Agriculture and Oklahoma Corporation Commission, for which the USEPA has retained permitting authority. The NPDES program in Oklahoma is implemented via Title 252, Chapter 606 of the Oklahoma Pollutant Discharge Elimination System (OPDES) Act, and in accordance with the agreement between ODEQ and USEPA relating to administration and enforcement of the delegated NPDES program. Implementation of WLAs for point sources is done through permits issued under the OPDES program.

SECTION 1
INTRODUCTION

1.1 TMDL Program Background

Section 303(d) of the Clean Water Act (CWA) and U.S. Environmental Protection Agency (USEPA) Water Quality Planning and Management Regulations (40 Code of Federal Regulations [CFR] Part 130) require states to develop total maximum daily loads (TMDL) for waterbodies not meeting designated uses where technology-based controls are in place. TMDLs establish the allowable loadings of pollutants or other quantifiable parameters for a waterbody based on the relationship between pollution sources and in-stream water quality conditions, so states can implement water quality-based controls to reduce pollution from point and nonpoint sources and restore and maintain water quality (USEPA 1991).

This report documents the data and assessment used to establish TMDLs for the pathogen indicator bacteria fecal coliform, *Escherichia coli (E. coli)*, or Enterococci for certain waterbodies in the Study Area. Elevated levels of pathogen indicator bacteria in aquatic environments indicate that a receiving water is contaminated with human or animal feces and that there is a potential health risk for individuals exposed to the water. Data assessment and TMDL calculations are conducted in accordance with requirements of Section 303(d) of the CWA, Water Quality Planning and Management Regulations (40 CFR Part 130), USEPA guidance, and Oklahoma Department of Environmental Quality (ODEQ) guidance and procedures. ODEQ is required to submit all TMDLs to USEPA for review and approval. Once the USEPA approves a TMDL, then the waterbody may be moved to Category 4a of a state's Integrated Water Quality Monitoring and Assessment Report, where it remains until compliance with water quality standards (WQS) is achieved (USEPA 2003).

The purpose of this TMDL report is to establish pollutant load allocations for indicator bacteria in impaired waterbodies, which is the first step toward restoring water quality and protecting public health. TMDLs determine the pollutant loading a waterbody can assimilate without exceeding the WQS for that pollutant. TMDLs also establish the pollutant load allocation necessary to meet the WQS established for a waterbody based on the relationship between pollutant sources and in-stream water quality conditions. A TMDL consists of a wasteload allocation (WLA), load allocation (LA), and a margin of safety (MOS). The WLA is the fraction of the total pollutant load apportioned to point sources, and includes stormwater discharges regulated under the National Pollutant Discharge Elimination System (NPDES) as point sources. The LA is the fraction of the total pollutant load apportioned to nonpoint sources. The MOS is a percentage of the TMDL set aside to account for the lack of knowledge associated with natural processes in aquatic systems, model assumptions, and data limitations.

This report does not stipulate specific control actions (regulatory controls) or management measures (voluntary best management practices) necessary to reduce bacteria loadings within each watershed. Watershed-specific control actions and management measures will be identified, selected, and implemented under a separate process involving stakeholders who live and work in the watersheds, tribes, and local, state, and federal government agencies.

This TMDL report focuses on 13 waterbodies that ODEQ placed in Category 5a of the 2008 Integrated Report [303(d) list] for nonsupport of primary body contact recreation (PBCR):

- Cimarron River (OK620910010010_00),
- Cooper Creek (OK620910020040_00),
- Deep Creek (OK620910020250_00),
- Elm Creek (OK620910020270_00),
- Indian Creek (OK620910020310_00),
- Skeleton Creek (OK620910030010_00),
- Cottonwood Creek (OK620910040010_20),
- Chisholm Creek (OK620910040100_00),
- Deer Creek (OK620910040120_00),
- Kingfisher Creek (OK620910050010_00),
- Trail Creek (OK620910050020_00),
- Uncle Johns Creek (OK620910050030_00), and
- Dead Indian Creek (OK620910050080_00).

Figure 1-1 is the location map showing the impaired segments of these Oklahoma waterbodies and their contributing watersheds. This map also displays the locations of the water quality monitoring (WQM) stations used as the basis for placement of these waterbodies on the Oklahoma 303(d) list. These waterbodies and their surrounding watersheds are hereinafter referred to as the Study Area.

Elevated levels of bacteria above the WQS result in the requirement that a TMDL be developed. The TMDLs established in this report are a necessary step in the process to develop the bacteria loading controls needed to restore the contact recreation use designated for each waterbody. Table 1-1 provides a description of the locations of the WQM stations on the 303(d)-listed waterbodies.

Table 1-1 Water Quality Monitoring Stations used for 2004 303(d) Listing Decision

Waterbody Name	Waterbody ID	WQM Station	WQM Station Location Descriptions
Cimarron River	OK620910010010_00	OK620910010010-001AT	Cimarron River, US77, Guthrie
Cooper Creek	OK620910020040_00	OK620910-02-0040C	Cooper Creek
Deep Creek	OK620910020250_00	OK620910-02-0250C	Deep Creek
Elm Creek	OK620910020270_00	OK620910-02-0270G	Elm Creek
Indian Creek	OK620910020310_00	OK620910-02-0310C	Indian Creek
Skeleton Creek	OK620910030010_00	OK620910030010-001AT OK620910-03-0010F OK620910-03-0010S	Skeleton Creek, SH74, Lovell Skeleton Creek: Lower Skeleton Creek: Upper
Cottonwood River	OK620910040010_20	OK620910-04-0010G	Cottonwood Creek
Chisholm Creek	OK620910040100_00	OK620910-04-0100G	Chisholm Creek
Deer Creek	OK620910040120_00	OK620910-04-0120B	Deer Creek: Logan County
Kingfisher Creek	OK620910050010_00	OK620910-05-0010G OK620910-05-0010J	Kingfisher Creek
Trail Creek	OK620910050020_00	OK620910-05-0020G	Trail Creek
Uncle Johns Creek	OK620910050030_00	OK620910-05-0030C	Uncle John’s Creek
Dead Indian Creek	OK620910050080_00	OK620910-05-0080D	Dead Indian Creek

1.2 Watershed Description

General. The watersheds in the Lower Cimarron-Skeleton Creek area addressed in these TMDLs are located in north-central Oklahoma. The 12 waterbodies included in this report are located in Alfalfa, Major, Garfield, Blaine, Kingfisher, Logan, Canadian, and Oklahoma Counties.

Within the Level IV ecoregion classification, most of the study area falls into the Prairie Tableland ecoregion. The Pleistocene Sand Dunes ecoregion is sandwiched in the middle section of the basin. The Cross Timbers Transition and the North Cross Timbers ecoregions lie to the east edge of the basin in Logan and Oklahoma counties.

Table 1-2, derived from the 2000 U.S. Census, demonstrates that with the exception of Oklahoma County and the metropolitan Oklahoma City portion of the Canadian and Garfield counties, the study area is mostly sparsely populated (U.S. Census Bureau 2000).

Table 1-2 County Population and Density

County Name	Population (2000 Census)	Population Density (per square mile)
Alfalfa	6,105	7.0
Major	7,545	7.9
Garfield	57,813	54.6
Blaine	11,976	12.9
Kingfisher	13,926	15.4
Logan	33,924	45.6
Canadian	87,697	97.4
Oklahoma	660,448	931.5

Climate. Table 1-3 summarizes the average annual precipitation for each watershed. Average annual precipitation values among the watersheds studied in this portion of Oklahoma ranges between 30.32 and 35.64 inches, increasing from the west to east (Oklahoma Climate Survey, 2005).

Land Use. Table 1-4 summarize the acreages and the corresponding percentages of the land use categories for the contributing watershed associated with each respective Oklahoma waterbody. The land use/land cover data were derived from the U.S. Geological Survey (USGS) 2001 National Land Cover Dataset (USGS 2007). The land use categories are displayed in Figure 1-2.

The combination of pasture/hay and cultivated crops are the dominant land use categories in all of the watersheds. Chisholm Creek is the only exception with 44% of the watershed in urban developed land uses, reflecting the fact that a significant portion of the watershed falls within the boundaries of the cities of Oklahoma City and Edmond.

Table 1-3 Average Annual Precipitation by Watershed

Study Area Precipitation Summary		
Waterbody Name	**Waterbody ID**	**Average Annual (Inches)**
Cimarron River	OK620910010010_00	35.64
Cooper Creek	OK620910020040_00	32.14
Deep Creek	OK620910020250_00	30.32
Elm Creek	OK620910020270_00	30.80
Indian Creek	OK620910020310_00	30.95
Skeleton Creek	OK620910030010_00	34.06
Cottonwood Creek	OK620910040010_20	34.76
Chisholm Creek	OK620910040100_00	35.57
Deer Creek	OK620910040120_00	35.26
Kingfisher Creek	OK620910050010_00	32.25
Trail Creek	OK620910050020_00	33.74
Uncle Johns Creek	OK620910050030_00	34.06
Dead Indian Creek	OK620910050080_00	33.11

The City of Guthrie has a small portion of its municipal boundaries crossing into the Cimarron River (OK620910010010_00) watershed. The four cities entirely or partially located in the Skeleton Creek (OK620910030010_00) watershed are Covington, Marshall, Douglas, and Crescent. Ringwood is located in Indian Creek watershed and Loyal is located in Cooper Creek watershed. The City of Kingfisher is scattered in the Kingfisher Creek watershed, Uncle Johns Creek watershed, and Trail Creek watershed. The City of Okarche straddles on Dead Indian Creek and Uncle Johns Creek watersheds. The City of Piedmont is located mainly in the Deer Creek and Cottonwood Creek watersheds, with small portions in the Uncle Johns Creek watershed. Cottonwood Creek watershed also has the city of Cashion. Large portions of the City of Oklahoma City are located in the Deer Creek and the Chisholm Creek watersheds. The Chisholm Creek watershed also has the Cities of Edmond, Nichols Hills, and the Village.

Table 1-4 Land Use Summaries by Watershed

Landuse Category	Cimarron River	Cooper Creek	Deep Creek	Elm Creek	Indian Creek	Skeleton Creek	Cottonwood Creek
Waterbody ID	OK620910010010_00	OK620910020040_00	OK620910020250_00	OK620910020270_00	OK620910020310_00	OK620910030010_00	OK620910040010_20
Percent of Open Water	4.68	0.24	0.22	0.07	0.34	0.62	1.56
Percent of Developed, Open Space	5.78	4.53	3.60	3.50	6.20	4.31	4.45
Percent of Developed, Low Intensity	0.47	0.26	0.98	1.36	0.69	0.11	0.27
Percent of Developed, Medium Intensity	0.38	0.01	0.04	0.01	0.10	0.02	0.04
Percent of Developed, High Intensity	0.04	0.00	0.01	0.01	0.03	0.01	0.03
Percent of Barren Land (Rock/Sand/ Clay)	0.63	0.04	0.24	0.01	0.09	0.00	0.00
Percent of Deciduous Forest	12.73	0.56	0.75	0.17	6.60	6.31	3.98
Percent of Evergreen Forest	6.05	0.68	4.31	0.60	1.69	2.07	0.36
Percent of Mixed Forest	0.00	0.00	0.08	0.01	0.00	0.00	0.00
Percent of Shrub/Scrub	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percent of Grassland/Herbaceous	45.35	29.87	33.92	27.12	30.35	45.38	39.96
Percent of Pasture/Hay	0.97	0.14	0.08	0.32	0.07	0.17	0.08
Percent of Cultivated Crops	22.42	63.66	55.75	66.85	53.85	41.01	49.25
Percent of Woody Wetlands	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Percent of Emergent Herbaceous Wetlands	0.52	0.00	0.00	0.00	0.00	0.00	0.00

Landuse Category							
	Cimarron River	**Cooper Creek**	**Deep Creek**	**Elm Creek**	**Indian Creek**	**Skeleton Creek**	**Cottonwood Creek**
Waterbody ID	**OK620910010010_00**	**OK620910020040_00**	**OK620910020250_00**	**OK620910020270_00**	**OK620910020310_00**	**OK620910030010_00**	**OK620910040010_20**
Acres Open Water	865	182	123	12	160	1,339	939
Acres Developed, Open Space	1,068	3,437	1,981	574	2,940	9,257	2,676
Acres[a] Developed, Low Intensity	86	195	538	222	328	242	161
Acres Developed, Medium Intensity	71	6	20	2	45	45	24
Acres Developed, High Intensity	7	4	3	2	15	13	20
Acres Barren Land (Rock/Sand/Clay)	116	32	131	1	43	0	2
Acres Deciduous Forest	2,350	424	414	27	3,129	13,551	2,394
Acres Evergreen Forest	1,118	513	2,369	99	799	4,439	216
Acres Mixed Forest	0	0	47	2	0	0	0
Acres Shrub/Scrub	0	0	0	0	0	0	0
Acres Grassland/Herbaceous	8,374	22,643	18,665	4,444	14,389	97,463	24,030
Acres Pasture/Hay	179	103	45	53	31	355	50
Acres Cultivated Crops	4,141	48,248	30,676	10,955	25,532	88,081	29,616
Acres Woody Wetlands	0	0	0	0	0	0	0
Acres Emergent Herbaceous Wetlands	96	0	2	0	0	0	0
Total (Acres)	**18,469**	**75,788**	**55,013**	**16,394**	**47,411**	**214,785**	**60,126**

Table 1-4 (cont'd) Land Use Summaries by Watershed

Landuse Category	Chisholm Creek	Deer Creek	Kingfisher Creek	Trail Creek	Uncle Johns Creek	Dead Indian Creek
Waterbody ID	OK620910040100_00	OK620910040120_00	OK620910050010_00	OK620910050020_00	OK620910050030_00	OK620910050080_00
Percent of Open Water	0.75	1.58	0.59	0.33	1.30	0.53
Percent of Developed, Open Space	13.27	5.98	3.87	4.53	4.71	3.39
Percent of Developed, Low Intensity	15.50	2.21	0.60	0.00	1.09	0.42
Percent of Developed, Medium Intensity	11.46	1.32	0.10	0.00	0.35	0.00
Percent of Developed, High Intensity	3.41	0.13	0.05	0.00	0.11	0.00
Percent of Barren Land (Rock/Sand/ Clay)	0.02	0.05	0.09	0.00	0.01	0.07
Percent of Deciduous Forest	11.54	6.86	1.58	1.63	2.80	1.22
Percent of Evergreen Forest	0.73	0.48	1.80	0.00	0.20	0.09
Percent of Mixed Forest	0.00	0.00	0.00	0.00	0.00	0.00
Percent of Shrub/Scrub	0.00	0.00	0.00	0.00	0.00	0.00
Percent of Grassland/Herbaceous	34.33	49.93	35.69	19.05	34.30	35.41
Percent of Pasture/Hay	0.79	0.40	0.10	0.00	0.09	0.29
Percent of Cultivated Crops	8.17	31.07	55.53	74.23	55.05	58.56
Percent of Woody Wetlands	0.00	0.00	0.00	0.00	0.00	0.00
Percent of Emergent Herbaceous Wetlands	0.00	0.00	0.00	0.00	0.00	0.00

Landuse Category	Chisholm Creek	Deer Creek	Kingfisher Creek	Trail Creek	Uncle Johns Creek	Dead Indian Creek
Waterbody ID	**OK620910040100_00**	**OK620910040120_00**	**OK620910050010_00**	**OK620910050020_00**	**OK620910050030_00**	**OK620910050080_00**
Acres Open Water	240	1,144	875	38	1,290	390
Acres Developed, Open Space	4,252	4,335	5,690	528	4,674	2,509
Acres[a] Developed, Low Intensity	4,967	1,605	885	0	1,077	310
Acres Developed, Medium Intensity	3,672	957	147	0	352	1
Acres Developed, High Intensity	1,094	96	70	0	108	0
Acres Barren Land (Rock/Sand/Clay)	7	39	137	0	15	50
Acres Deciduous Forest	3,699	4,974	2,322	190	2,782	905
Acres Evergreen Forest	234	344	2,650	0	197	65
Acres Mixed Forest	0	0	0	0	0	0
Acres Shrub/Scrub	0	0	0	0	0	0
Acres Grassland/Herbaceous	11,001	36,189	52,507	2,220	34,030	26,171
Acres Pasture/Hay	254	287	148	0	88	212
Acres Cultivated Crops	2,619	22,516	81,691	8,648	54,612	43,281
Acres Woody Wetlands	0	0	0	0	0	0
Acres Emergent Herbaceous Wetlands	0	0	0	0	0	0
Total (Acres)	**32,040**	**72,487**	**147,123**	**11,624**	**99,225**	**73,893**

Figure 1-1 Watersheds Not Supporting Primary Body Contact Recreation Use within the Study Area

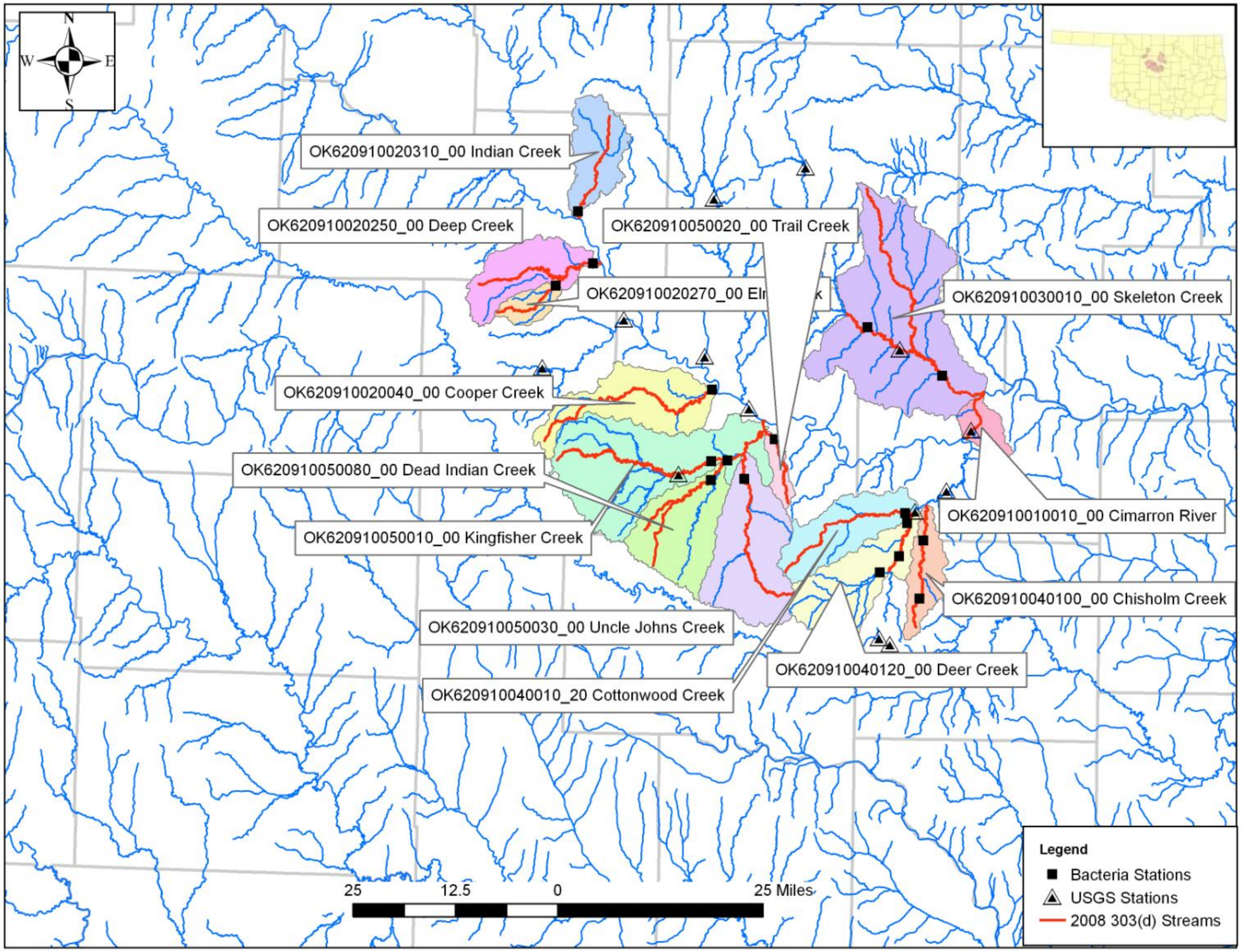
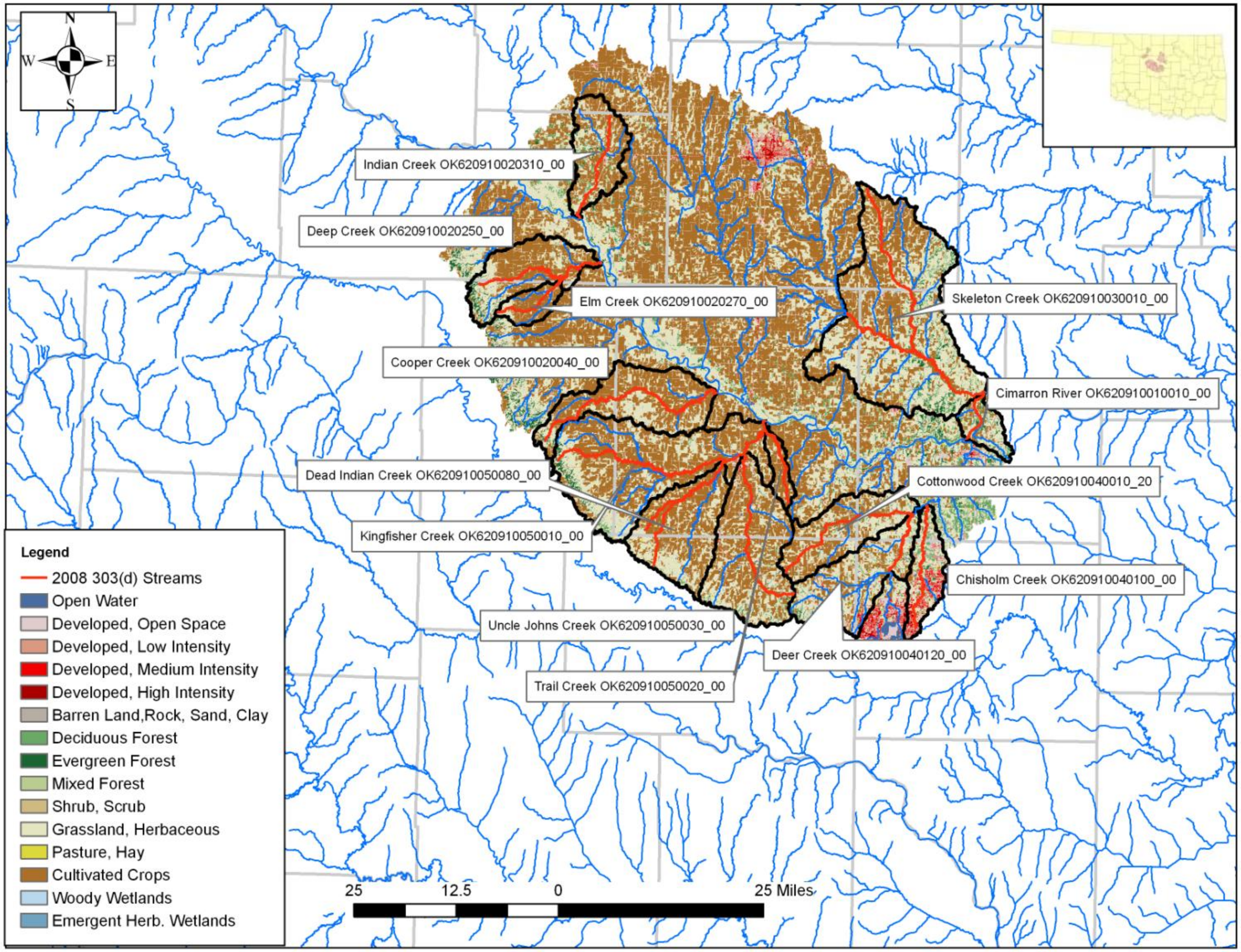


Figure 1-2 Land Use Map by Watershed



SECTION 2
PROBLEM IDENTIFICATION AND WATER QUALITY TARGET

2.1 Oklahoma Water Quality Standards

Title 785 of the Oklahoma Administrative Code includes Oklahoma's water quality standards (OWRB 2008a). The OWRB has statutory authority and responsibility concerning establishment of state water quality standards, as provided under 82 Oklahoma Statute [O.S.], §1085.30. This statute authorizes the OWRB to promulgate rules …*which establish classifications of uses of waters of the state, criteria to maintain and protect such classifications, and other standards or policies pertaining to the quality of such waters.* [O.S. 82:1085:30(A)]. Beneficial uses are designated for all waters of the state. Such uses are protected through restrictions imposed by the antidegradation policy statement, narrative water quality criteria, and numerical criteria (OWRB 2008a). The beneficial uses designated for the stream segments in this TMDL include PBCR and other various uses. The TMDLs in this report only address the PBCR-designated use. Table 2-1, an excerpt from Appendix C of the 2008 Integrated Report (ODEQ 2008), summarizes the PBCR use attainment status for the waterbodies of the Study Area and targeted TMDL date. The priority for targeting TMDL development and implementation is derived from the chronological order of the dates listed in the TMDL Date column of Table 2-1. The TMDLs established in this report are a necessary step in the process to restore the PBCR use designation for each waterbody.

Table 2-1 Excerpt from the 2008 Integrated Report – Comprehensive Waterbody Assessment Category List

Waterbody ID	Waterbody Name	Stream Miles	Category	TMDL Date	Primary Body Contact Recreation
OK620910010010_00	Cimarron River	8.33	5	2019	N
OK620910020040_00	Cooper Creek	40.27	5	2016	N
OK620910020250_00	Deep Creek	25.42	5	2019	N
OK620910020270_00	Elm Creek	14.15	5	2019	N
OK620910020310_00	Indian Creek	16.71	5	2019	N
OK620910030010_00	Skeleton Creek	32.84	5	2019	N
OK620910040010_20	Cottonwood Creek	24.39	5	2010	N
OK620910040100_00	Chisholm Creek	21.15	5	2010	N
OK620910040120_00	Deer Creek	12.67	5	2010	N

Waterbody ID	Waterbody Name	Stream Miles	Category	TMDL Date	Primary Body Contact Recreation
OK620910050010_00	Kingfisher Creek	47.37	5	2019	N
OK620910050020_00	Trail Creek	14.87	5	2019	N
OK620910050030_00	Uncle Johns Creek	27.49	5	2019	N
OK620910050080_00	Dead Indian Creek	24.23	5	2019	N

N = Not Supporting; Source: 2008 Integrated Report, ODEQ 2008

The definition of PBCR is summarized by the following excerpt from Chapter 45 of the Oklahoma WQS.

(a) Primary Body Contact Recreation involves direct body contact with the water where a possibility of ingestion exists. In these cases the water shall not contain chemical, physical or biological substances in concentrations that are irritating to skin or sense organs or are toxic or cause illness upon ingestion by human beings.

(b) In waters designated for Primary Body Contact Recreation...limits...shall apply only during the recreation period of May 1 to September 30. The criteria for Secondary Body Contact Recreation will apply during the remainder of the year.

To implement Oklahoma's WQS for PBCR, OWRB promulgated Chapter 46, *Implementation of Oklahoma's Water Quality Standards* (OWRB 2008b). The excerpt below from Chapter 46: 785:46-15-6, stipulates how water quality data will be assessed to determine support of the PBCR use as well as how the water quality target for TMDLs will be defined for each bacteria indicator.

(a) Scope. The provisions of this Section shall be used to determine whether the subcategory of Primary Body Contact of the beneficial use of Recreation designated in OAC 785:45 for a waterbody is supported during the recreation season from May 1 through September 30 each year. Where data exist for multiple bacterial indicators on the same waterbody or waterbody segment, the determination of use support shall be based upon the use and application of all applicable tests and data.

(b) Screening levels.

(1) The screening level for fecal coliform shall be a density of 400 colonies per 100ml.

(2) The screening level for Escherichia coli shall be a density of 235 colonies per 100 ml in streams designated in OAC 785:45 as Scenic Rivers and in lakes, and 406 colonies per 100 ml in all other waters of the state designated as Primary Body Contact Recreation.

(3) The screening level for Enterococci shall be a density of 61 colonies per 100 ml in streams designated in OAC 785:45 as Scenic Rivers and in lakes, and 108 colonies per 100 ml in all other waters of the state designated as Primary Body Contact Recreation.

(c) Fecal coliform:

(1) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be fully supported with respect to fecal coliform if the geometric mean of 400 colonies per 100 ml is met and no greater than 25% of the sample concentrations from that waterbody exceed the screening level prescribed in (b) of this Section.

(2) The parameter of fecal coliform is not susceptible to an assessment that Primary Body Contact Recreation is partially supported.

(3) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be not supported with respect to fecal coliform if the geometric mean of 400 colonies per 100 ml is not met, or greater than 25% of the sample concentrations from that waterbody exceed the screening level prescribed in (b) of this Section, or both such conditions exist.

(d) Escherichia coli (E. coli):

(1) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be fully supported with respect to E. coli if the geometric mean of 126 colonies per 100 ml is met, or the sample concentrations from that waterbody taken during the recreation season do not exceed the screening level prescribed in (b) of this Section, or both such conditions exist.

(2) The parameter of E. coli is not susceptible to an assessment that Primary Body Contact Recreation is partially supported.

(3) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be not supported with respect to E. coli if the geometric mean of 126 colonies per 100 ml is not met and any of the sample concentrations from that waterbody taken during the recreation season exceed a screening level prescribed in (b) of this Section.

(e) Enterococci:

(1) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be fully supported with respect to Enterococci if the geometric mean of 33 colonies per 100 ml is met, or the sample concentrations from that waterbody taken during the recreation season do not exceed the screening level prescribed in (b) of this Section, or both such conditions exist.

(2) The parameter of Enterococci is not susceptible to an assessment that Primary Body Contact Recreation is partially supported.

(3) The Primary Body Contact Recreation subcategory designated for a waterbody shall be deemed to be not supported with respect to Enterococci if the geometric mean of 33 colonies per 100 ml is not met and any of the sample concentrations from that waterbody taken during the recreation season exceed a screening level prescribed in (b) of this Section.

Compliance with the Oklahoma WQS is based on meeting requirements for all three bacteria indicators. Where concurrent data exist for multiple bacterial indicators on the same waterbody or waterbody segment, each indicator group must demonstrate compliance with the numeric criteria prescribed (OWRB 2008a).

As stipulated in the WQS, utilization of the geometric mean to determine compliance for any of the three indicator bacteria depends on the collection of five samples within a 30-day period. For most stream segments in Oklahoma there are insufficient data available to calculate the 30-day geometric mean since most water quality samples are collected once a month. As a result, waterbodies placed on the 303(d) list for not supporting the PBCR are the result of individual samples exceeding the instantaneous criteria or the long-term geometric mean of individual samples exceeding the geometric mean criteria for each respective bacteria indicator. Targeting the instantaneous criterion established for the primary contact recreation season (May 1st to September 30th) as the water quality goal for TMDLs corresponds to the basis for 303(d) listing and may be protective of the geometric mean criterion as well as the criteria for the secondary contact recreation season. However, both the instantaneous and geometric mean criteria for *E. coli* and Enterococci will be evaluated as water quality targets to ensure the most protective goal is established for each waterbody.

The specific data assessment method for listing indicator bacteria based on instantaneous or single sample criterion is detailed in Oklahoma's 2008 Integrated Report. As stated in the report, a minimum of 10 samples collected between May 1st and September 30th (during the primary recreation season) is required to list a segment for *E. coli* and Enterococci. In addition only data that were collected from the most recent five primary recreation seasons are used in attainment assessment and TMDL calculations. In case that there are less than 10 primary recreation season samples available from the five seasons, one more season is backtracked to add more samples. This process is repeated until 10 samples are obtained or no more data are available.

A sample quantity exception exists for fecal coliform that allows waterbodies to be listed for nonsupport of PBCR if there are less than 10 samples. The assessment method states that if there are less than 10 samples and the existing sample set already assures a nonsupport determination, then the waterbody should be listed for TMDL development. This condition is true in any case where the small sample set demonstrates that at least three out of six samples exceed the single sample fecal coliform criterion. In this case if four more samples were available to meet minimum of 10 samples, this would still translate to >25 percent exceedance or nonsupport of PBCR (*i.e.,* three out of 10 samples = 33 percent exceedance). For *E. coli* and Enterococci, the 10-sample minimum was used, without exception, in attainment determination.

2.2 Problem Identification

Table 2-2 summarizes water quality data collected during the primary contact recreation season from the stream segments between 2000 and 2007 for each indicator bacteria. Water quality data from the primary contact recreation seasons used in this TMDL assessment are provided in Appendix A. For the data collected between 2000 and 2007, evidence of nonsupport of the PBCR use based only on fecal coliform concentrations was observed in four waterbodies: Elm Creek (OK620910020270_00), Cottonwood Creek (OK620910040010_20), Deer Creek (OK620910040120_00), and Trail Creek (OK620910050020_00). Evidence of nonsupport of the PBCR use based only on Enterococci concentrations was observed in one waterbody: Cimarron River (OK620910010010_00). Evidence of nonsupport of the PBCR use based on both *E. coli* and Enterococci was observed in five waterbodies: Cooper Creek (OK620910020040_00), Deep Creek (OK620910020250_00), Indian Creek

(OK620910020310_00), Uncle Johns Creek (OK620910050030_00) and Dead Indian Creek (OK620910050080_00). Lastly, evidence of nonsupport for all three bacteria indicators was observed in Skeleton Creek (OK620910030010_00) and Kingfisher Creek (OK620910050010_00). Table 2-3 summarizes the waterbodies requiring TMDLs for not supporting PBCR.

2.3 Water Quality Target

The Code of Federal Regulations (40 CFR §130.7(c)(1)) states that, "TMDLs shall be established at levels necessary to attain and maintain the applicable narrative and numerical water quality standards." For the waterbodies requiring TMDLs in this report, defining the water quality target is somewhat complicated by the use of three different bacteria indicators with three different numeric criteria for determining attainment of PBCR use as defined in the Oklahoma WQS. As previously stated, because available bacteria data were collected on an approximate monthly basis (see Appendix A) instead of at least five samples over a 30–day period, data for these TMDLs are analyzed and presented in relation to the instantaneous criteria for fecal coliform and both the instantaneous and a long-term geometric mean for both *E. coli* and Enterococci.

All TMDLs for fecal coliform must take into account that no more than 25 percent of the samples may exceed the instantaneous numeric criteria. For *E. coli* and Enterococci, no samples may exceed instantaneous criteria. Since the attainability of stream beneficial uses for *E. coli* and Enterococci is based on the compliance of either the instantaneous or a long-term geometric mean criterion, percent reductions goals will be calculated for both criteria. TMDLs will be based on the percent reduction required to meet either the instantaneous or long-term geometric mean criterion, whichever is less.

The water quality target for each waterbody will also incorporate an explicit 10 percent MOS. For example, if fecal coliform is utilized to establish the TMDL, then the water quality target is 360 organisms per 100 milliliters (mL), 10 percent lower than the instantaneous water quality criteria (400/100 mL). For *E. coli* the instantaneous water quality target is 365 organisms/100 mL, which is 10 percent lower than the criterion value (406/100 mL), and the geometric mean water quality target is 113 organisms/100 mL, which is 10 percent lower than the criterion value (126/100 mL). For Enterococci the instantaneous water quality target is 97/100 mL, which is 10 percent lower than the criterion value (108/100 mL) and the geometric mean water quality target is 30 organisms/100 mL, which is 10 percent lower than the criterion value (33/100 mL).

Each water quality target will be used to determine the allowable bacteria load which is derived by using the actual or estimated flow record multiplied by the in-stream criteria minus a 10 percent MOS.

Table 2-2 Summary of Indicator Bacteria Samples from Primary Contact Recreation Season, 2000-2007

Waterbody ID	Waterbody Name	Indicator Bacteria	Single Sample Water Quality Criterion (#/100ml)	Geometric Mean Concentration (count/100ml)	Number of Samples	Number of Samples Exceeding Single Sample Criterion	% of Samples Exceeding Single Sample Criterion	Reason for Listing Change*
OK620910010010_00	Cimarron River	FC	400	94.9	18	2	11%	Delist: < 400 Geo Mean & <25% exceeding
		EC	406	84.5	18	4	22%	
		ENT	108	60.5	18	5	28%	
OK620910020040_00	Cooper Creek	FC	400	NA	0	NA	NA	
		EC	406	136	11	4	36%	List: > 126 Geo Mean
		ENT	108	214	11	6	55%	
OK620910020250_00	Deep Creek	FC	400	NA	0	NA	NA	
		EC	406	215	12	5	42%	
		ENT	108	199	12	9	75%	
OK620910020270_00	Elm Creek	FC	400	298	9	3	33%	List: > 25%
		EC	406	59	6	2	33%	Delist: Low Sample Count
		ENT	108	132	6	3	50%	Delist: Low Sample Count
OK620910020310_00	Indian Creek	FC	400	NA	0	NA	NA	
		EC	406	144	11	2	18%	List: > 126 Geo Mean
		ENT	108	256	11	9	82%	
OK620910030010_00	Skeleton Creek	FC	400	293	19	7	37%	
		EC	406	155	31	10	32%	List: > 126 Geo Mean
		ENT	108	284	31	20	65%	
OK620910040010_20	Cottonwood Creek	FC	400	525	7	3	43%	List: > 25%
		EC	406	168	5	1	20%	Delist: Low Sample Count
		ENT	108	648	5	5	100%	Delist: Low Sample Count
OK620910040100_00	Chisholm Creek	FC	400	326	9	2	22%	
		EC	406	82	8	0	0%	
		ENT	108	79	6	1	17%	Delist: Low Sample Count
OK620910040120_00	Deer Creek	FC	400	249	9	3	33%	List: > 25%
		EC	406	157	6	1	17%	Delist: Low Sample Count
		ENT	108	456	6	6	100%	Delist: Low Sample Count
OK620910050010_00	Kingfisher	FC	400	281	9	3	33%	List: > 25%

Waterbody ID	Waterbody Name	Indicator Bacteria	Single Sample Water Quality Criterion (#/100ml)	Geometric Mean Concentration (count/100ml)	Number of Samples	Number of Samples Exceeding Single Sample Criterion	% of Samples Exceeding Single Sample Criterion	Reason for Listing Change*
	Creek	EC	406	264	11	6	55%	
		ENT	108	393	11	10	91%	
OK620910050020_00	Trail Creek	FC	400	420	9	4	44%	
		EC	406	152	6	1	17%	Delist: Low Sample Count
		ENT	108	660	6	6	100%	Delist: Low Sample Count
OK620910050030_00	Uncle Johns Creek	FC	400	NA	0	NA	NA	
		EC	406	171	11	3	27%	List: > 126 Geo Mean
		ENT	108	479	11	11	100%	
OK620910050080_00	Dead Indian Creek	FC	400	NA	0	NA	NA	
		EC	406	411	11	5	45%	
		ENT	108	507	11	10	91%	

EC = *E. coli*; ENT = Enterococci; FC = fecal coliform
Highlighted bacteria indicators require TMDL*

Table 2-3 Waterbodies Requiring TMDLs for Not Supporting Primary Contact Recreation Use

WQM Station	Waterbody ID	Waterbody Name	Indicator Bacteria		
			FC	*E. coli*	ENT
OK620910010010-001AT	OK620910010010_00	Cimarron River			X
OK620910-02-0040C	OK620910020040_00	Cooper Creek		X	X
OK620910-02-0250C	OK620910020250_00	Deep Creek		X	X
OK620910-02-0270G	OK620910020270_00	Elm Creek	X		
OK620910-02-0310C	OK620910020310_00	Indian Creek		X	X
OK620910030010-001AT OK620910-03-0010F OK620910-03-0010S	OK620910030010_00	Skeleton Creek	X	X	X
OK620910-04-0010G	OK620910040010_20	Cottonwood Creek	X		
OK620910-04-0100G	OK620910040100_00	Chisholm Creek			
OK620910-04-0120B	OK620910040120_00	Deer Creek	X		
OK620910-05-0010G OK620910-05-0010J	OK620910050010_00	Kingfisher Creek	X	X	X
OK620910-05-0020G	OK620910050020_00	Trail Creek	X		
OK620910-05-0030C	OK620910050030_00	Uncle Johns Creek		X	X
OK620910-05-0080D	OK620910050080_00	Dead Indian Creek		X	X

ENT = Enterococci; FC = fecal coliform

SECTION 3
POLLUTANT SOURCE ASSESSMENT

A source assessment characterizes known and suspected sources of pollutant loading to impaired waterbodies. Sources within a watershed are categorized and quantified to the extent that information is available. Bacteria originate from humans and warm-blooded animals. Sources may be point or nonpoint in nature.

Point sources are permitted through the NPDES program. NPDES-permitted facilities that discharge treated wastewater are required to monitor for one of the three bacteria indicators (fecal coliform, *E coli*, or Enterococci) in accordance with its permit. Nonpoint sources are diffuse sources that typically cannot be identified as entering a waterbody through a discrete conveyance at a single location. These sources may involve land activities that contribute bacteria to surface water as a result of rainfall runoff. For the TMDLs in this report, all sources of pollutant loading not regulated by NPDES are considered nonpoint sources. The following discussion describes what is known regarding point and nonpoint sources of bacteria in the impaired watersheds.

3.1 NPDES-Permitted Facilities

Under 40CFR, §122.2, a point source is described as a discernable, confined, and discrete conveyance from which pollutants are or may be discharged to surface waters. Certain NPDES-permitted municipal plants are classified as no-discharge facilities. NPDES-permitted facilities classified as point sources that may contribute bacteria loading include:

- NPDES municipal wastewater treatment plants (WWTP);
- NPDES municipal no-discharge WWTP;
- NPDES municipal separate storm sewer discharge (MS4); and
- NPDES Concentrated Animal Feeding Operation (CAFO).

Continuous point source discharges such as WWTPs, could result in discharge of elevated concentrations of fecal coliform bacteria if the disinfection unit is not properly maintained, is of poor design, or if flow rates are above the disinfection capacity. While the no-discharge facilities do not discharge wastewater directly to a waterbody, it is possible that the collection systems associated with each facility may be a source of bacteria loading to surface waters. Stormwater runoff from MS4 areas, which is now regulated under the USEPA NPDES Program, can also contain high bacteria concentrations. CAFOs are recognized by USEPA as potential significant sources of pollution, and may cause serious impacts to water quality if not properly managed.

There are no NPDES-permitted facilities of any type in the contributing watersheds of Cimarron River (OK620910010010_00), Deep Creek, Elm Creek, Trail Creek, and Uncle Johns Creek.

Six of the 12 watersheds in the Study Area (excluding Chisholm Creek), including Indian Creek (OK620910020310_00), Skeleton Creek (OK620910030010_00), Cottonwood Creek (OK620910040010_20), Deer Creek (OK620910040120_00), Kingfisher Creek (OK620910050010_00), and Dead Indian Creek (OK620910050080_00) have one or more continuous point source discharger.

3.1.1 Continuous Point Source Discharges

The locations of the NPDES-permitted facilities which discharge wastewater to surface waters addressed in these TMDLs are shown in Figure 3-1 and listed in Table 3-1. For the purposes of the pollutant source assessment only facility types identified in Table 3-1 as Municipal are assumed to contribute bacteria loads within the watersheds of the impaired waterbodies. For some continuous point source discharge facilities the permitted design flow was not available and therefore is not provided in Table 3-1.

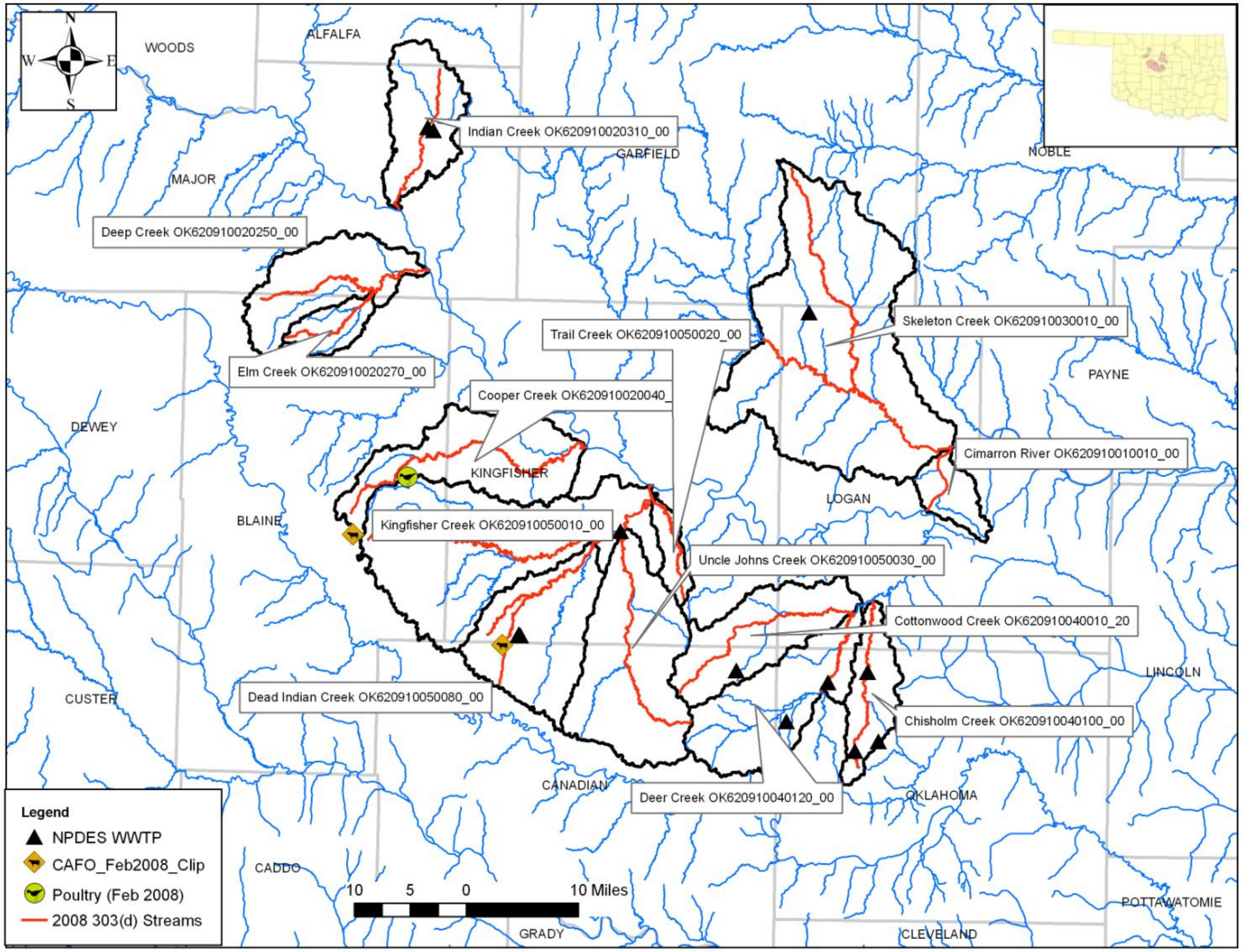
Table 3-1 Point Source Discharges in the Study Area

NPDES Permit No.	Name	Receiving Water	Facility Type	County Name	Design Flow (mgd)	Active/ Inactive	Facility ID
OK0022811	Kingfisher Public Works Auth.	OK620910050010_00 Kingfisher Creek	Municipal	Kingfisher	0.8	Active	S20920
OK0027561	OK City Wtr Utils Trust-Deer C	OK620910040120_00 Deer Creek	Municipal	Oklahoma	15	Active	S20970
OK0036994	Duke Energy Field Services, LP	Unnamed Trib Of Berryhill Creek (to Dead Indian Creek)	Industrial	Kingfisher	N/A	Active	37000290
OK0041378	Warren Energy Resources-Ringwood	N/A	Industrial	Major	N/A	Inactive	44000130
OKG580004	Marshall, Town Of	OK620910030110 Horse Creek (to Skeleton Creek)	Municipal	Logan	0.053	Active	S20935
OKG580047	Ringwood, Town Of	OK620910020310_00 Indian Creek	Municipal	Major	0.052	Active	S20910
OKG830015	Leslie Wiedemann	N/A	Industrial	Canadian	N/A	Inactive	9200010
OKG830032	T & M Timesaver	N/A	Industrial	Oklahoma	N/A	Inactive	55006010

N/A = not available

Discharge Monitoring Reports (DMR) were used to determine the number of fecal coliform analyses performed from 1997 through 2007, the maximum concentration during this period, the number of violations occurring when the monthly geometric mean concentration exceeded 200 colony forming units (cfu)/100 mL, and the number of violations when a daily maximum concentration exceeded 400 cfu/100 mL. DMR data for fecal coliform were only available for the Oklahoma City Water Utilities' Deer Creek plant and the Kingfisher plant (see Appendix B). These data indicate that there were no geometric mean or maximum concentration violations occurring at the Kingfisher plant. Over the 11-year period, the Oklahoma City Deer Creek plant did not have any geometric mean violations. However, the plant had some maximum daily concentration violations recorded (15% of the time).

Figure 3-1 Locations of NPDES-Permitted Facilities, CAFO and Poultry Operations in the Study Area



3.1.2 No-Discharge Facilities and SSOs

There are 12 recorded no-discharge facilities in the Study Area. For the purposes of these TMDLs, no-discharge facilities do not contribute bacteria loading to the Cimarron River and its tributaries. However, it is possible the wastewater collection systems associated with those WWTPs could be a source of bacteria loading, or that discharges may occur during large rainfall events that exceed the systems' storage capacities.

Table 3-2 NPDES No-Discharge Facilities in the Study Area

Facility	Facility ID	County	Facility Type	Type	Watershed
Dolese Piedmont Batch Plant	09000380	Canadian	Total Retention	Industrial	Deer Creek OK620910040120_00
GPM Kingfisher Plant	37000270	Kingfisher	Total Retention	Industrial	Cottonwood Creek OK620910040010_00
Schwarz Ready Mix - Rockwell Plant	55005010	Oklahoma	Total Retention	Industrial	Deer Creek OK620910040120_00
Cashion WWT	S20923	Kingfisher	Lagoon (Total Retention)	Municipal	Cottonwood Creek OK620910040010_00
Covington WWT	S20936	Garfield	Lagoon (Total Retention)	Municipal	Skeleton Creek OK620910030010_00
Northwest MHP WWT	S20958	Canadian	Lagoon (Total Retention)	Municipal	Uncle Johns Creek OK620910050030_00
Piedmont WWT	S20996	Canadian	Land Application	Municipal	Deer Creek OK620910040120_00
PSG	S20970	Oklahoma	Land Application	Municipal	Deer Creek OK620910040120_00
Kingfisher	S20920	Kingfisher	Land Application	Municipal	Kingfisher Creek OK620910050010_00
Guthrie	S20930	Logan	Land Application	Municipal	Cimarron River OK620910010010_00
Marshall	S20935	Logan	Land Application	Municipal	Skeleton Creek OK620910030010_00

N/A = not available

Sanitary sewer overflows (SSO) from wastewater collection systems, although infrequent, can be a major source of fecal coliform loading to streams. SSOs have existed since the introduction of separate sanitary sewers, and most are caused by blockage of sewer pipes by grease, tree roots, and other debris that clog sewer lines, by sewer line breaks and leaks, cross connections with storm sewers, and inflow and infiltration of groundwater into sanitary sewers. SSOs are permit violations that must be addressed by the responsible NPDES permittee. The reporting of SSOs has been strongly encouraged by USEPA, primarily through enforcement and fines. While not all sewer overflows are reported, ODEQ has some data on SSOs available. There were 511 SSO occurrences, ranging from 0 gallon (negligible amount) to 4.5 million gallons, reported for certain watersheds within the Study Area between January 1997 and June 2009 which are summarized in Table 3-2. Additional data on each individual SSO event are provided in Appendix B. Given the significant number of occurrences and the size of overflows reported, bacteria from SSOs could have been a significant source of bacteria loading in the past in the Deer Creek, Skeleton Creek, Kingfisher Creek and Cimarron River watersheds.

Table 3-3 Sanitary Sewer Overflow Summary

Facility Name	NPDES Permit No.	Receiving Water	Facility ID	Number of Occurrences	Date Range		Amount (Gallons)	
					From	To	Min	Max
Ringwood	OKG580047	OK620910020310_00 Indian Creek	S20910	1	7/24/2007	--	100	--
Kingfisher	OK0022811	OK620910050010_00 Kingfisher Creek	S20920	41	2/20/1997	4/10/2008	22	4.5m
Guthrie	--	OK620910010010_00 Cimarron River	S20930	222	3/18/1997	6/5/2009	1	500,000
Covington	--	OK620910030010_00 Skeleton Creek	S20936	10	5/7/1998	5/30/2007	0	> 4m
OK City-Deer Cr	OK0027561	OK620910040120_00 Deer Creek	S20970	220	1/27/1997	6/14/2009	5	2.5m
Piedmont	--	OK620910040120_00 Deer Creek	S20996	17	2/4/1997	8/23/2005	1	65,000

SSOs are a common result of the aging wastewater infrastructure around the state. DEQ has been ahead of other states and, in some cases EPA itself in its handling of SSOs. Due to the widespread nature of the SSO problem, DEQ has focused its limited resources to first target SSOs that result in definitive environmental harm, such as fish kills, or lead to citizen complaints. All SSOs falling in these two categories are addressed through DEQ's formal enforcement process. A Notice of Violation (NOV) is first issued to the owner of the collection system and a Consent Order (CO) is negotiated between the owner and DEQ to establish a schedule for necessary collection system upgrades to eliminate future SSOs.

Another target area for DEQ is chronic SSOs from OPDES major facilities, those with a total design flow in excess of 1 MGD. DEQ periodically reviews the bypass reports submitted by these major facilities and identifies problem areas and chronic SSOs. When these problems are attributable to wet weather, DEQ endeavors to enter into a CO with the owner of the collection system to establish a schedule for necessary repairs. When the problems seem to be dry weather-related, DEQ will encourage the owner of the collection system to implement the proposed Capacity, Management, Operation, and Maintenance (CMOM) guidelines aimed at minimizing or eliminating dry weather SSOs. This is often accomplished through entering into a Consent Order to establish a schedule for implementation and annual auditing of the CMOM program.

All SSOs are considered unpermitted discharges under State statute and DEQ regulations. The smaller towns have a smaller reserve, are more likely to use utility revenue for general purposes, and/or tend to budget less for ongoing and/or preventive maintenance. If and when DEQ becomes aware of chronic SSOs (more than one from a single location in a year) or receives a complaint about an SSO in a smaller community, DEQ will pursue enforcement action. Enforcement almost always begins with the issuance of an NOV and, if the problem is not corrected by a long-term solution, DEQ will enter into a CO with the facility for a long-term solution. Long-term solutions usually begin with sanitary sewer evaluation surveys (SSESs). Based on the result of the SSES, the facilities can prioritize and take corrective action.

3.1.3 NPDES Municipal Separate Storm Sewer Discharge (MS4)

Phase I MS4

In 1990 the USEPA developed rules establishing Phase I of the NPDES Stormwater Program, designed to prevent harmful pollutants from being washed by stormwater runoff into MS4s (or from being dumped directly into the MS4) and then discharged into local water bodies (USEPA 2005). Phase I of the program required operators of medium and large MS4s (those generally serving populations of 100,000 or greater) to implement a stormwater management program as a means to control polluted discharges. Approved stormwater management programs for medium and large MS4s are required to address a variety of water quality-related issues, including roadway runoff management, municipal-owned operations, and hazardous waste treatment. There is one Phase I MS4 permit in the Study Area: the City of Oklahoma City. Urbanized area of Oklahoma City occupies portions of two watersheds in the Study Area, 4,111 acres in the Deer Creek (OK620910040120_00) watershed or 5.7% of the watershed and 9,146 acres in the Chisholm Creek (OK620910040100_00) watershed or 28.5% of the watershed. Because new assessment showed that Chisholm Creek was not impaired for PBCR using any of the bacteria indicators, TMDL was not developed for the waterbody. Consequently, no bacteria load reduction requirements were set for Oklahoma City's MS4 areas in the Chisholm Creek watershed.

Phase II MS4s

Phase II of the rules developed by the USEPA extends coverage of the NPDES Stormwater Program to certain small MS4s. Small MS4s are defined as any MS4 that is not a medium or large MS4 covered by Phase I of the NPDES Stormwater Program. Phase II requires operators of regulated small MS4s to obtain NPDES permits and develop a stormwater management program. Programs are designed to reduce discharges of pollutants to the "maximum extent practicable," protect water quality, and satisfy appropriate water quality requirements of the CWA. Because stormwater discharges cannot be centrally collected, monitored, and treated, they are not subject to the same types of effluent limitations as wastewater facilities. Instead, stormwater discharges are required to meet a performance standard of providing treatment to the "maximum extent practical" through the implementation of best management practices (BMPs).

Small MS4 stormwater programs must address the following minimum control measures:

- Public Education and Outreach;
- Public Participation/Involvement;
- Illicit Discharge Detection and Elimination;
- Construction Site Runoff Control;
- Post- Construction Runoff Control; and
- Pollution Prevention/Good Housekeeping.

The small MS4 General Permit for communities in Oklahoma became effective on February 8, 2005. However, there are cities or other entities in the study area fall under requirements designated by USEPA for inclusion in the Phase II Stormwater Program.

ODEQ provides information on the current status of their MS4 programs on its website found at: http://www.deq.state.ok.us/WQDnew/stormwater/ms4/

3.1.4 Concentrated Animal Feeding Operations

The Agricultural Environmental Management Services (AEMS) of the Oklahoma Department of Agriculture, Food and Forestry (ODAFF) was created to help develop, coordinate, and oversee environmental policies and programs aimed at protecting the Oklahoma environment from pollutants associated with agricultural animals and their waste. Through regulations established by the Oklahoma Concentrated Animal Feeding Operation Act, AEMS works with producers and concerned citizens to ensure that animal waste does not impact the waters of the state. A CAFO is an animal feeding operation that confines and feeds at least 1,000 animal units for 45 days or more in a 12-month period (ODAFF 2005). The CAFO Act is designed to protect water quality through the use of best management practices (BMP) such as dikes, berms, terraces, ditches, or other similar structures used to isolate animal waste from outside surface drainage, except for a 25-year, 24–hour rainfall event (ODAFF 2005). CAFOs are considered no-discharge facilities.

CAFOs are designated by USEPA as potential significant sources of pollution, and may cause serious impacts to water quality if not managed properly. Potential problems for CAFOs can include animal waste discharges to waters of the state and failure to properly operate wastewater lagoons.

Regulated CAFOs within the watershed operate under NPDES permits issued and overseen by EPA. In order to comply with this TMDL, those CAFO permits in the watershed and their associated management plans must be reviewed. Further actions to reduce bacteria loads and achieve progress toward meeting the specified reduction goals must be implemented. This provision will be forwarded to EPA, as the responsible permitting agency, for follow up. Figure 3-1 depicts the location of the CAFOs, located in Dead Indian Creek (OK620910050080_00) and Cooper Creek (OK620910020040_00) watersheds. Table 3-4 lists the CAFOs located in the Study Area. Note that the CAFO OKG010081 has only part of its operation located in the Cooper Creek watershed.

Table 3-4 NPDES-Permitted CAFOs in Study Area

ODAFF Owner ID	EPA Facility ID	ODAFF ID	ODAFF License Number	Maximum Number of Permitted Animals at Facility			Total # of Animal Units at Facility	County	Watershed
				Dairy Heifers	Dairy Cattle	Slaughter Feeder Cattle			
AGN007154	OKG010026	59	4	0	0	3000	3000	Canadian	OK620910050080_00 Dead Indian Creek
AGR001534*	OKG010081	309	97	0	0	45,000	45,000	Blaine	OK620910020040_00 Cooper Creek*

* This CAFO has only part of its operation located in the Cooper Creek watershed. The remainder of the operation is outside the study area for this TMDL report.

3.2 Nonpoint Sources

Nonpoint sources include those sources that cannot be identified as entering the waterbody at a specific location. Bacteria originate from rural, suburban, and urban areas. The following section describes possible major nonpoint sources contributing fecal coliform loading within the Study Area.

These sources include wildlife, various agricultural activities and domesticated animals, land application fields, urban runoff, failing onsite wastewater disposal (OSWD) systems, and domestic pets. As previously stated in Subsection 3.1, there are no NPDES-permitted facilities of any type in the contributing watersheds of Deep Creek, Elm Creek, Trail Creek, and Uncle Johns Creek; therefore, nonsupport of PBCR use is caused by nonpoint sources of bacteria only in these waterbodies.

Bacteria associated with urban runoff can emanate from humans, wildlife, commercially raised farm animals, and domestic pets. Water quality data collected from streams draining urban communities often show existing concentrations of fecal coliform bacteria at levels greater than a state's instantaneous standards. A study under USEPA's National Urban Runoff Project indicated that the average fecal coliform concentration from 14 watersheds in different areas within the United States was approximately 15,000 /100 mL in stormwater runoff (USEPA 1983). Runoff from urban areas not permitted under the MS4 program can be a significant source of fecal coliform bacteria. Water quality data collected from streams draining many of the nonpermitted communities show existing loads of fecal coliform bacteria at levels greater than the State's instantaneous standards. Best management practices (BMP) such as buffer strips, repair of leaking sewage collection systems and proper disposal of domestic animal waste can reduce bacteria loading to waterbodies.

3.2.1 Wildlife

Fecal coliform bacteria are produced by all warm-blooded animals, including wildlife such as mammals and birds. In developing bacteria TMDLs it is important to identify the potential for bacteria contributions from wildlife by watershed. Wildlife is naturally attracted to riparian corridors of streams and rivers. With direct access to the stream channel, wildlife can be a concentrated source of bacteria loading to a waterbody. Bacteria from wildlife are also deposited onto land surfaces, where it may be washed into nearby streams by rainfall runoff. Currently there are insufficient data available to estimate populations and spatial distribution of wildlife and avian species by watershed. Consequently it is difficult to assess the magnitude of bacteria contributions from wildlife species as a general category.

However, adequate data are available by county to estimate the number of deer by watershed. This report assumes that deer habitat includes forests, croplands, and pastures. Using Oklahoma Department of Wildlife Conservation county data, the population of deer can be roughly estimated from the actual number of deer harvested and harvest rate estimates. Because harvest success varies from year to year based on weather and other factors, the average harvest from 1999 to 2003 was combined with an estimated annual harvest rate of 20 percent to predict deer population by county. Using the estimated deer population by county and the percentage of the watershed area within each county, a wild deer population can be calculated for each watershed. Table 3-5 provides the estimated number of deer for each watershed.

Table 3-5 Estimated Deer Populations

Waterbody ID	Waterbody Name	Deer	Acre
OK620910010010_00	Cimarron River	187	18,466
OK620910020040_00	Cooper Creek	497	75,794
OK620910020250_00	Deep Creek	540	55,019
OK620910020270_00	Elm Creek	106	16,387
OK620910020310_00	Indian Creek	546	47,417
OK620910030010_00	Skeleton Creek	1,768	214,767
OK620910040010_20	Cottonwood Creek	470	60,137
OK620910040120_00	Deer Creek	484	72,473
OK620910050010_00	Kingfisher Creek	963	147,121
OK620910050020_00	Trail Creek	77	11,651
OK620910050030_00	Uncle Johns Creek	664	99,211
OK620910050080_00	Dead Indian Creek	492	73,909

According to a study conducted by ASAE (the American Society of Agricultural Engineers), deer release approximately $5x10^8$ fecal coliform units per animal per day (ASAE 1999). Although only a fraction of the total fecal coliform loading produced by the deer population may actually enter a waterbody, the estimated fecal coliform production for deer provided in Table 3-6 in cfu/day provides a relative magnitude of loading in each watershed.

Table 3-6 Estimated Fecal Coliform Production for Deer

Waterbody ID	Waterbody Name	Watershed Area (acres)	Wild Deer Population	Estimated Wild Deer per acre	Fecal Production (x 10^8 cfu/day) of Deer Population
OK620910010010_00	Cimarron River	18,466	187	0.010	936
OK620910020040_00	Cooper Creek	75,794	497	0.007	2,483
OK620910020250_00	Deep Creek	55,019	540	0.010	2,701
OK620910020270_00	Elm Creek	16,387	106	0.006	531
OK620910020310_00	Indian Creek	47,417	546	0.012	2,730
OK620910030010_00	Skeleton Creek	214,767	1,768	0.008	8,842
OK620910040010_20	Cottonwood Creek	60,137	470	0.008	2,348
OK620910040120_00	Deer Creek	72,473	484	0.007	2,419
OK620910050010_00	Kingfisher Creek	147,121	963	0.007	4,813
OK620910050020_00	Trail Creek	11,651	77	0.007	384
OK620910050030_00	Uncle Johns Creek	99,211	664	0.007	3,318
OK620910050080_00	Dead Indian Creek	73,909	492	0.007	2,462

3.2.2 Non-Permitted Agricultural Activities and Domesticated Animals

There are a number of non-permitted agricultural activities that can also be sources of fecal bacteria loading. Agricultural activities of greatest concern are typically those associated with livestock operations (Drapcho and Hubbs 2002). The following are examples of commercial raised farm animal activities that can contribute to bacteria sources:

- Processed commercially raised farm animal manure is often applied to fields as fertilizer, and can contribute to fecal bacteria loading to waterbodies if washed into streams by runoff.
- Animals grazing in pastures deposits manure containing fecal bacteria onto land surfaces. These bacteria may be washed into waterbodies by runoff.
- Animals often have direct access to waterbodies and can provide a concentrated source of fecal bacteria loading directly into streams.

Table 3-7 provides estimated numbers of commercially raised farm animals by watershed based on the 2002 U.S. Department of Agriculture (USDA) county agricultural census data (USDA 2002). The estimated animal populations in Table 3-7 were derived by using the percentage of the watershed within each county. Because the watersheds are generally much smaller than the counties, and commercially raised farm animals are not evenly distributed across counties or constant with time, these are rough estimates only. Among the animal groups represented, cattle are the most abundant species in the Study Area, generate the largest amount of fecal coliform and often have direct access to the impaired waterbodies or their tributaries.

Detailed information is not available to describe or quantify the relationship between in-stream concentrations of bacteria and land application of manure. The estimated acreage by watershed where manure was applied in 2002 is shown in Table 3-7. These estimates are also based on the county level reports from the 2002 USDA county agricultural census, and thus represent approximations of the land application area in each watershed. Because of the lack of specific data, land application of animal manure is not quantified in Table 3-7 but is considered a potential source of bacteria loading to the waterbodies in the Study Area. Most poultry feeding operations are regulated by ODAFF, and are required to land apply chicken waste in accordance with their Animal Waste Management Plans or Comprehensive Nutrient Management Plans. While these plans are not designed to control bacteria loading, best management practices and conservation measures, if properly implemented, could greatly reduce the contribution of bacteria from this group of animals to the watershed.

According to a study conducted by the ASAE, the daily fecal coliform production rates by species were estimated as follows (ASAE 1999):

Table 3-7 Commercially Raised Farm Animals and Manure Application Area Estimates by Watershed

Waterbody ID	Waterbody Name	Cattle & Calves-all	Dairy Cows	Horses & Ponies	Goats	Sheep & Lambs	Hogs & Pigs	Ducks & Geese	Chickens & Turkeys	Acres of Manure Application
OK620910010010_00	Cimarron River	2,529	20	105	0	147	17	4	56	38
OK620910020040_00	Cooper Creek	14,475	174	133	0	249	19	4	102	538
OK620910020250_00	Deep Creek	8,270	61	76	0	95	15	2	83	82
OK620910020270_00	Elm Creek	2,501	12	22	0	9	14	1	0	36
OK620910020310_00	Indian Creek	7,225	60	64	0	110	31	1	98	48
OK620910030010_00	Skeleton Creek	31,068	268	832	0	1,430	163	36	536	684
OK620910040010_20	Cottonwood Creek	10,175	122	256	0	306	353	10	144	263
OK620910040120_00	Deer Creek	8,857	107	462	0	253	635	39	261	205
OK620910050010_00	Kingfisher Creek	27,410	311	256	0	435	72	8	177	952
OK620910050020_00	Trail Creek	2,423	35	23	0	52	0	1	23	108
OK620910050030_00	Uncle Johns Creek	18,238	242	367	0	356	937	16	202	503
OK620910050080_00	Dead Indian Creek	14,057	191	239	0	283	514	10	149	457

- Beef cattle release approximately 1.04E+11 fecal coliform counts per animal per day;
- Dairy cattle release approximately 1.01E+11 per animal per day
- Swine release approximately 1.08E+10 per animal per day
- Chickens release approximately 1.36E+08 per animal per day
- Sheep release approximately 1.20E+10 per animal per day
- Horses release approximately 4.20E+08 per animal per day;
- Turkey release approximately 9.30E+07 per animal per day
- Ducks release approximately 2.43E+09 per animal per day
- Geese release approximately 4.90E+10 per animal per day

Using the estimated animal populations and the fecal coliform production rates from ASAE, an estimate of fecal coliform production from each group of commercially raised farm animals was calculated in Table 3-9 for each watershed of the Study Area. Note that only a small fraction of these fecal coliform are expected to represent loading into waterbodies, either washed into streams by runoff or by direct deposition from wading animals. Cattle appear to represent the largest potential source of fecal bacteria among the animal groups represented. For informational purposes, data on poultry operations provided by Oklahoma Department of Agriculture, Food and Forestry (ODAFF) are provided in Table 3-8. This poultry data was last updated in February 2008. Table 3-8 lists an estimated number of birds within select watersheds for which data are available. These numbers are considered more representative since they are based on the number of contract poultry operations within the selected watershed because they are derived from an ODAFF geographic information system inventory. The general location of poultry operations are shown in Figure 3-1. However, for consistency, estimated fecal coliform production for the general category of poultry is based on USDA county agriculture census numbers as summarized in Table 3-7.

Table 3-8 Estimated Poultry Numbers for Contract Growers Inventoried by ODAFF

Waterbody ID	Waterbody Name	County	Type	Estimated Birds
OK620910050010_00	Kingfisher Creek	Blaine	Layers	20,000

Table 3-9 Fecal Coliform Production Estimates for Commercially Raised Farm Animals (x10^9 number/day)

Waterbody ID	Waterbody Name	Cattle & Calves-all	Dairy Cows	Horses & Ponies	Goats	Sheep & Lambs	Hogs & Pigs	Ducks & Geese	Chickens & Turkeys	Total
OK620910010010_00	Cimarron River	262,983	2,032	44	N/A	1,768	186	56.6	7.34	267,078
OK620910020040_00	Cooper Creek	1,505,446	17,579	56	N/A	2,983	210	64.0	13.32	1,526,351
OK620910020250_00	Deep Creek	860,108	6,163	32	N/A	1,138	166	31.6	10.79	867,648
OK620910020270_00	Elm Creek	260,151	1,199	9	N/A	104	147	11.7	0.02	261,622
OK620910020310_00	Indian Creek	751,405	6,044	27	N/A	1,314	332	21.7	12.74	759,156
OK620910030010_00	Skeleton Creek	3,231,052	27,108	350	N/A	17,157	1,761	550.9	69.62	3,278,048
OK620910040010_20	Cottonwood Creek	1,058,206	12,301	108	N/A	3,677	3,814	159.9	18.71	1,078,284
OK620910040120_00	Deer Creek	921,089	10,780	194	N/A	3,039	6,855	604.9	33.93	942,596
OK620910050010_00	Kingfisher Creek	2,850,643	31,386	108	N/A	5,223	782	126.3	23.02	2,888,291
OK620910050020_00	Trail Creek	251,992	3,523	9	N/A	630	0	10.5	2.95	256,168
OK620910050030_00	Uncle Johns Creek	1,896,763	24,472	154	N/A	4,268	10,121	245.1	26.22	1,936,049
OK620910050080_00	Dead Indian Creek	1,461,932	19,317	100	N/A	3,394	5,553	152.0	19.32	1,490,467

3.2.3 Failing Onsite Wastewater Disposal Systems and Illicit Discharges

ODEQ is responsible for implementing the regulations of Title 252, Chapter 641 of the Oklahoma Administrative Code, which defines design standards for individual and small public onsite sewage disposal systems (ODEQ 2004). OSWD systems and illicit discharges can be a source of bacteria loading to streams and rivers. Bacteria loading from failing OSWD systems can be transported to streams in a variety of ways, including runoff from surface ponding or through groundwater. Fecal coliform-contaminated groundwater discharges to creeks through springs and seeps.

To estimate the potential magnitude of OSWDs fecal bacteria loading, the number of OSWD systems was estimated for each watershed. The estimate of OSWD systems was derived by using data from the 1990 U.S. Census (U.S. Census Bureau 2000). The density of OSWD systems within each watershed was estimated by dividing the number of OSWD systems in each census block by the number of acres in each census block. This density was then applied to the number of acres of each census block within a stream segment watershed. Census blocks crossing a watershed boundary required additional calculation to estimate the number of OSWD systems based on the proportion of the census tracts falling within each watershed. This step involved adding all OSWD systems for each whole or partial census block.

Over time, most OSWD systems operating at full capacity will fail. OSWD system failures are proportional to the adequacy of a state's minimum design criteria (Hall 2002). The 1995 American Housing Survey conducted by the U.S. Census Bureau estimates that, nationwide, 10 percent of occupied homes with OSWD systems experience malfunctions during the year (U.S. Census Bureau 1995). A study conducted by Reed, Stowe & Yanke, LLC (2001) reported that approximately 12 percent of the OSWD systems in East Texas (adjacent to the Study Area) were chronically malfunctioning. Most studies estimate that the minimum lot size necessary to ensure against contamination is roughly one-half to one acre (Hall 2002). Some studies, however, found that lot sizes in this range or even larger could still cause contamination of ground or surface water (University of Florida 1987). It is estimated that areas with more than 40 OSWD systems per square mile (6.25 septic systems per 100 acres) can be considered to have potential contamination problems (Canter and Knox 1986). Table 3-10 summarizes estimates of sewered and unsewered households for each watershed in the Study Area.

For the purpose of estimating fecal coliform loading in watersheds, an OSWD failure rate of 12 percent was used. Using this 12 percent failure rate, calculations were made to characterize fecal coliform loads in each watershed.

Fecal coliform loads were estimated using the following equation (USEPA 2001):

$$\#\frac{counts}{day} = \left(\#Failing\_systems\right) \times \left(\frac{10^6\,counts}{100ml}\right) \times \left(\frac{70gal}{personday}\right) \times \left(\#\frac{person}{household}\right) \times \left(3785.2\,\frac{ml}{gal}\right)$$

Table 3-10 Estimates of Sewered and Unsewered Households

Waterbody ID	Waterbody Name	Public Sewer	Septic Tank	Other Means	Housing Units	% Sewered
OK620910010010_00	Cimarron River	263	146	2	390	67%
OK620910020040_00	Cooper Creek	59	200	0	212	28%
OK620910020250_00	Deep Creek	127	208	8	291	44%
OK620910020270_00	Elm Creek	71	44	3	115	62%
OK620910020310_00	Indian Creek	218	228	9	343	63%
OK620910030010_00	Skeleton Creek	830	553	56	1,101	75%
OK620910040010_20	Cottonwood Creek	208	870	2	1,546	13%
OK620910040120_00	Deer Creek	4,290	1,411	1	7,398	58%
OK620910050010_00	Kingfisher Creek	999	548	1	1,637	61%
OK620910050020_00	Trail Creek	10	46	1	84	12%
OK620910050030_00	Uncle Johns Creek	1,226	571	2	1,413	87%
OK620910050080_00	Dead Indian Creek	164	229	0	554	30%

The average of number of people per household was calculated to be 2.56 for counties in the Study Area (U.S. Census Bureau 2000). Approximately 70 gallons of wastewater were estimated to be produced on average per person per day (Metcalf and Eddy 1991). The fecal coliform concentration in septic tank effluent was estimated to be 10^6 per 100 mL of effluent based on reported concentrations from a number of published reports (Metcalf and Eddy 1991; Canter and Knox 1985; Cogger and Carlile 1984). Using this information, the estimated load from failing septic systems within the watersheds was summarized below in Table 3-11.

Table 3-11 Estimated Fecal Coliform Load from OSWD Systems

Waterbody ID	Waterbody Name	Acres	Septic Tank	# of Failing Septic Tanks	Estimated Loads from Septic Tanks (x 10^9 counts/day)
OK620910010010_00	Cimarron River	18,466	146	18	119
OK620910020040_00	Cooper Creek	75,794	200	24	162
OK620910020250_00	Deep Creek	55,019	208	25	169
OK620910020270_00	Elm Creek	16,387	44	5	36
OK620910020310_00	Indian Creek	47,417	228	27	185
OK620910030010_00	Skeleton Creek	214,767	553	66	449
OK620910040010_20	Cottonwood Creek	60,137	870	104	707
OK620910040120_00	Deer Creek	72,473	1,411	169	1,147
OK620910050010_00	Kingfisher Creek	147,121	548	66	445
OK620910050020_00	Trail Creek	11,651	46	6	37
OK620910050030_00	Uncle Johns Creek	99,211	571	69	464
OK620910050080_00	Dead Indian Creek	73,909	229	28	186

3.2.4 Domestic Pets

Fecal matter from dogs and cats is transported to streams by runoff from urban and suburban areas and can be a potential source of bacteria loading. On average nationally, there are 0.58 dogs per household and 0.66 cats per household (American Veterinary Medical Association 2004). Using the U.S. Census data at the block level (U.S. Census Bureau 2000), dog and cat populations can be estimated for each watershed. Table 3-12 summarizes the estimated number of dogs and cats for the watersheds of the Study Area.

Table 3-12 Estimated Numbers of Pets

Waterbody ID	Waterbody Name	Dogs	Cats
OK620910010010_00	Cimarron River	556	633
OK620910020040_00	Cooper Creek	375	426
OK620910020250_00	Deep Creek	425	484
OK620910020270_00	Elm Creek	161	183
OK620910020310_00	Indian Creek	667	759
OK620910030010_00	Skeleton Creek	1,606	1,828
OK620910040010_20	Cottonwood Creek	2,588	2,945
OK620910040120_00	Deer Creek	11,972	13,623
OK620910050010_00	Kingfisher Creek	2,467	2,807
OK620910050020_00	Trail Creek	134	152
OK620910050030_00	Uncle Johns Creek	2,205	2,509
OK620910050080_00	Dead Indian Creek	832	947

Table 3-13 provides an estimate of the fecal coliform load from pets. These estimates are based on estimated fecal coliform production rates of 5.4×10^8 per day for cats and 3.3×10^9 per day for dogs (Schueler 2000).

Table 3-13 Estimated Fecal Coliform Daily Production by Pets (x 10^9)

Waterbody ID	Waterbody Name	Dogs	Cats	Total
OK620910010010_00	Cimarron River	1,835	342	2,177
OK620910020040_00	Cooper Creek	1,236	230	1,466
OK620910020250_00	Deep Creek	1,403	261	1,665
OK620910020270_00	Elm Creek	532	99	631
OK620910020310_00	Indian Creek	2,202	410	2,613
OK620910030010_00	Skeleton Creek	5,301	987	6,288
OK620910040010_20	Cottonwood Creek	8,540	1,590	10,130
OK620910040120_00	Deer Creek	39,507	7,357	46,864
OK620910050010_00	Kingfisher Creek	8,141	1,516	9,657
OK620910050020_00	Trail Creek	442	82	524
OK620910050030_00	Uncle Johns Creek	7,275	1,355	8,630
OK620910050080_00	Dead Indian Creek	2,747	512	3,258

3.3 Summary of Bacteria Sources

Table 3-14 summarizes the suspected sources of bacteria loading in each impaired watershed. Since there are no NPDES-permitted discharge facilities present in the Cimarron River, Cooper Creek, Deep Creek, Elm Creek, Trail Creek, and Uncle Johns Creek watersheds, nonsupport of the PBCR use is caused entirely by nonpoint sources. In five of the other seven watersheds since most point sources are relatively minor and for the most part tend to meet instream water quality criteria in their effluent, nonpoint sources are considered to be the major source of bacteria loading. Given the volume of discharge from point sources and the relatively large MS4 areas in the Deer Creek watersheds, point source loading may be significant.

Table 3-14 Estimated Major Source of Bacteria Loading by Watershed

Waterbody ID	Waterbody Name	Point Sources	Nonpoint Sources	Major Source
OK620910010010_00	Cimarron River	No	Yes	Nonpoint
OK620910020040_00	Cooper Creek	No	Yes	Nonpoint
OK620910020250_00	Deep Creek	No	Yes	Nonpoint
OK620910020270_00	Elm Creek	No	Yes	Nonpoint
OK620910020310_00	Indian Creek	Yes	Yes	Nonpoint
OK620910030010_00	Skeleton Creek	Yes	Yes	Nonpoint
OK620910040010_20	Cottonwood Creek	Yes	Yes	Nonpoint
OK620910040120_00	Deer Creek	Yes	Yes	Point/Nonpoint
OK620910050010_00	Kingfisher Creek	Yes	Yes	Nonpoint
OK620910050020_00	Trail Creek	No	Yes	Nonpoint
OK620910050030_00	Uncle Johns Creek	No	Yes	Nonpoint
OK620910050080_00	Dead Indian Creek	Yes	Yes	Nonpoint

Table 3-15 below provides a summary of the estimated fecal coliform loads in percentage for the four major nonpoint source categories (commercially raised farm animals, pets, deer, and septic tanks) that are contributing to the elevated bacteria concentrations in each watershed. Commercially raised farm animals are estimated to be the primary contributors of fecal coliform loading to land surfaces. It must be noted that while no data are available to estimate populations and fecal loading of wildlife other than deer, a number of bacteria source tracking studies demonstrate that wild birds and mammals represent a major source of the fecal bacteria found in streams.

The magnitude of loading to a stream may not reflect the magnitude of loading to land surfaces. While no studies quantify these effects, bacteria may die off or survive at different rates depending on the manure characteristics and a number of other environmental conditions. Manure handling practices, use of BMPs, and relative location to streams can also affect stream loading. Also, the structural properties of some manure, such as cow patties, may limit their wash off into streams by runoff. Because litter is applied in a pulverized form, it could be a larger source during storm runoff events. The Shoal Creek report by the Missouri Department of Natural Resources showed that poultry litter was about 71% of the high flow load and cow pats contributed only about 28% of it (MDNR, 2003). The Shoal Creek report also showed that poultry litter was insignificant under low flow conditions up to 50% frequency. In contrast, malfunctioning septic tank effluent may be present in pooled water on the surface, or in shallow groundwater, which may enhance its conveyance to streams.

Table 3-15 Summary of Fecal Coliform Load Estimates from Various Sources to Land Surfaces

Waterbody ID	Waterbody Name	Commercially Raised Farm Animals	Pets	Deer	Estimated Loads from Septic Tanks
OK620910010010_00	Cimarron River	98.8%	0.8%	0.3%	0.0%
OK620910020040_00	Cooper Creek	99.7%	0.1%	0.2%	0.0%
OK620910020250_00	Deep Creek	99.5%	0.2%	0.3%	0.0%
OK620910020270_00	Elm Creek	99.5%	0.2%	0.2%	0.0%
OK620910020310_00	Indian Creek	99.3%	0.3%	0.4%	0.0%
OK620910030010_00	Skeleton Creek	99.5%	0.2%	0.3%	0.0%
OK620910040010_20	Cottonwood Creek	98.8%	0.9%	0.2%	0.1%
OK620910040120_00	Deer Creek	94.9%	4.7%	0.2%	0.1%
OK620910050010_00	Kingfisher Creek	99.5%	0.3%	0.2%	0.0%
OK620910050020_00	Trail Creek	99.6%	0.2%	0.1%	0.0%
OK620910050030_00	Uncle Johns Creek	99.4%	0.4%	0.2%	0.0%
OK620910050080_00	Dead Indian Creek	99.6%	0.2%	0.2%	0.0%

SECTION 4
TECHNICAL APPROACH AND METHODS

The objective of a TMDL is to estimate allowable pollutant loads and to allocate these loads to the known pollutant sources in the watershed so appropriate control measures can be implemented and the WQS achieved. A TMDL is expressed as the sum of three elements as described in the following mathematical equation:

$$TMDL = \Sigma\ WLA + \Sigma\ LA + MOS$$

The WLA is the portion of the TMDL allocated to existing and future point sources. The LA is the portion of the TMDL allocated to nonpoint sources, including natural background sources. The MOS is intended to ensure that WQSs will be met. Thus, the allowable pollutant load that can be allocated to point and nonpoint sources can then be defined as the TMDL minus the MOS.

40 CFR, §130.2(1), states that TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures. For fecal coliform, *E. coli*, or Enterococci bacteria, TMDLs are expressed as colony-forming units per day, where possible, or as a percent reduction goal (PRG), and represent the maximum one-day load the stream can assimilate while still attaining the WQS.

4.1 Using Load Duration Curves to Develop TMDLs

The TMDL calculations presented in this report are derived from load duration curves (LDC). LDCs facilitate rapid development of TMDLs, and as a TMDL development tool, are effective at identifying whether impairments are associated with point or nonpoint sources. The technical approach for using LDCs for TMDL development includes the four following steps that are described in Subsections 4.2 through 4.4 below:

- Preparing flow duration curves for gaged and ungaged stream segments;
- Estimating existing bacteria loading in the receiving water using ambient water quality data;
- Using LDCs to identify the critical condition that will dictate loading reductions necessary to attain WQS; and
- Interpreting LDCs to derive TMDL elements – WLA, LA, MOS, and PRG.

Historically, in developing WLAs for pollutants from point sources, it was customary to designate a critical low flow condition (*e.g.*, 7Q2) at which the maximum permissible loading was calculated. As water quality management efforts expanded in scope to quantitatively address nonpoint sources of pollution and types of pollutants, it became clear that this single critical low flow condition was inadequate to ensure adequate water quality across a range of flow conditions. Use of the LDC obviates the need to determine a design storm or selected flow recurrence interval with which to characterize the appropriate flow level for the assessment of critical conditions. For waterbodies impacted by both point and nonpoint sources, the “nonpoint source critical condition” would typically occur during high flows, when rainfall runoff would contribute the bulk of the pollutant load, while the “point source critical condition” would typically occur during low flows, when WWTP effluents would dominate the base flow of the impaired water. However, violations that occur during low flows may not be caused exclusively by point sources. Violations have been noted in some watersheds that contain no point sources. Research has shown that bacteria loading in streams during low flow conditions may be due to direct deposit of cattle manure into streams and faulty septic tank/lateral field systems.

LDCs display the maximum allowable load over the complete range of flow conditions by a line using the calculation of flow multiplied by the water quality criterion. The TMDL can be expressed as a continuous function of flow, equal to the line, or as a discrete value derived from a specific flow condition.

4.2 Development of Flow Duration Curves

Flow duration curves serve as the foundation of LDCs and are graphical representations of the flow characteristics of a stream at a given site. Flow duration curves utilize the historical hydrologic record from stream gages to forecast future recurrence frequencies. Many streams throughout Oklahoma do not have long term flow data and therefore, flow frequencies must be estimated. The most basic method to estimate flows at an ungaged site involves 1) identifying an upstream or downstream flow gage; 2) calculating the contributing drainage areas of the ungaged sites and the flow gage; and 3) calculating daily flows at the ungaged site by using the flow at the gaged site multiplied by the drainage area ratio. The more complex approach used here also considers watershed differences in rainfall, land use, and the hydrologic properties of soil that govern runoff and retention. More than one upstream flow gage may also be considered. A more detailed explanation of the methods for estimating flow at ungaged streams stations is provided in Appendix C.

Flow duration curves are a type of cumulative distribution function. The flow duration curve represents the fraction of flow observations that exceed a given flow at the site of interest. The observed flow values are first ranked from highest to lowest then, for each observation, the percentage of observations exceeding that flow is calculated. The flow value is read from the ordinate (y-axis), which is typically on a logarithmic scale since the high flows would otherwise overwhelm the low flows. The flow exceedance frequency is read from the abscissa, which is numbered from 0 to 100 percent, and may or may not be logarithmic. The lowest measured flow occurs at an exceedance frequency of 100 percent indicating that flow has equaled or exceeded this value 100 percent of the time, while the highest measured flow is found at an exceedance frequency of 0 percent. The median flow occurs at a flow exceedance frequency of 50 percent. The flow exceedance percentiles for each stream segment addressed in this report are provided in Appendix C.

While the number of observations required to develop a flow duration curve is not rigorously specified, a flow duration curve is usually based on more than 1 year of observations, and encompasses inter-annual and seasonal variation. Ideally, the drought of record and flood of record are included in the observations. For this purpose, the long-term flow gaging stations operated by the USGS are utilized (USGS 2007a).

A typical semi-log flow duration curve exhibits a sigmoidal shape, bending upward near a flow exceedance frequency value of 0 percent and downward at a frequency near 100 percent, often with a relatively constant slope in between. For sites that on occasion exhibit no flow, the curve will intersect the abscissa at a frequency less than 100 percent. As the number of observations at a site increases, the line of the LDC tends to appear smoother. However, at extreme low and high flow values, flow duration curves may exhibit a "stair step" effect due to the USGS flow data rounding conventions near the limits of quantification.

Figures 4-1 through 4-12 are flow duration curves for each impaired waterbody. The flow duration curve for Cimarron River, segment OK620910010010_00 was based on measured flows at USGS gage station 07160000 (Cimarron River near Guthrie, OK). This gage is co-located with WQM station OK620910010010-001AT. The flow period used for this station was 1937 through 2007.

No flow gage exists on Cooper Creek, segment OK620910020040_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07158400 (Salt Creek near Okeene, OK). The flow period used for this station was 1961 through 1979.

No flow gage exists on Deep Creek, segment OK620910020250_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07158400 (Salt Creek near Okeene, OK). The flow period used for this station was 1961 through 1979.

No flow gage exists on Elm Creek, segment OK620910020270_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07158400 (Salt Creek near Okeene, OK). The flow period used for this station was 1961 through 1979.

No flow gage exists on Indian Creek, segment OK620910020310_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07158400 (Salt Creek near Okeene, OK). The flow period used for this station was 1961 through 1979.

The flow duration curve for Skeleton Creek, segment OK620910030010_00 was based on measured flows at USGS gage station 07160500 (Skeleton Creek near Lovell, OK). This gage is co-located with WQM station OK620910030010-001AT. The flow period used for this station was 1949 through 2007.

No flow gage exists on Cottonwood Creek, segment OK620910040010_20. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07159720 (Cottonwood Creek near Navina, OK). The flow period used for this station was 1977 through 1989.

No flow gage exists on Deer Creek, segment OK620910040120_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07159720 (Cottonwood Creek near Navina, OK). The flow period used for this station was 1977 through 1989.

The flow duration curve for Kingfisher Creek, segment OK620910050010_00 was based on measured flows at USGS gage station 07159200 (Kingfisher Creek near Kingfisher, OK) from 1966-1970. To obtain a flow record of at least 10 years for the development of a flow duration curve, additional flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07259000 (Turkey Creek near Drummond, OK). The flow period used from this station was 1960 through 1966.

No flow gage exists on Trail Creek, segment OK620910050020_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage stations 07159200 (Kingfisher Creek near Kingfisher, OK) from 1966-1970 and USGS gage station 07259000 (Turkey Creek near Drummond, OK) from 1960 through 1966.

No flow gage exists on Uncle Johns Creek, segment OK620910050030_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage stations 07159200 (Kingfisher Creek near Kingfisher, OK) from 1966-1970 and USGS gage station 07259000 (Turkey Creek near Drummond, OK) from 1960 through 1966.

No flow gage exists on Dead Indian Creek, segment OK620910050080_00. Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage stations 07159200 (Kingfisher Creek near Kingfisher, OK) from 1966-1970 and USGS gage station 07259000 (Turkey Creek near Drummond, OK) from 1960 through 1966.

Figure 4-1

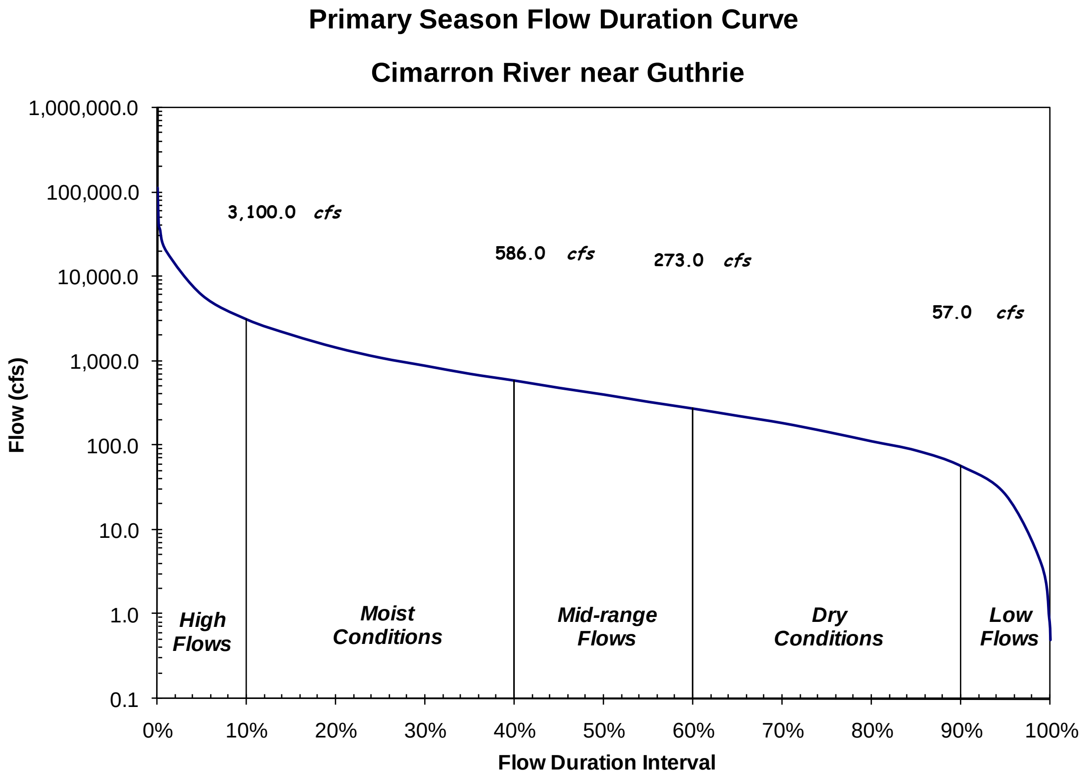


Figure 4-2

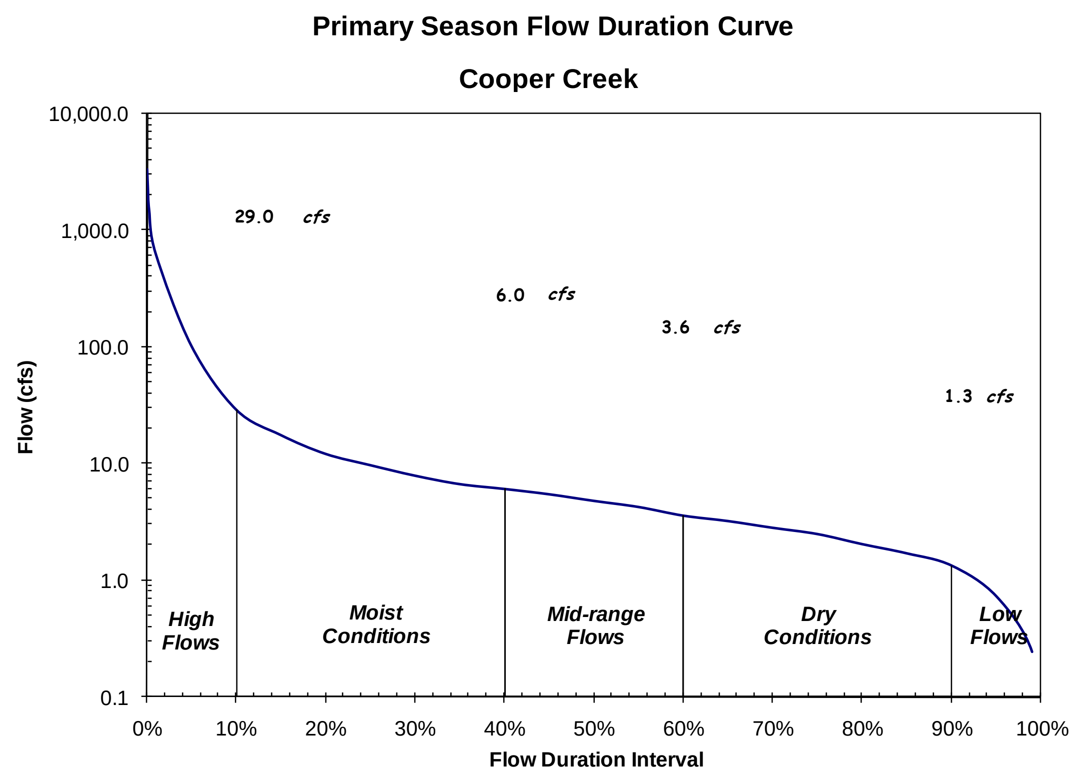


Figure 4-3

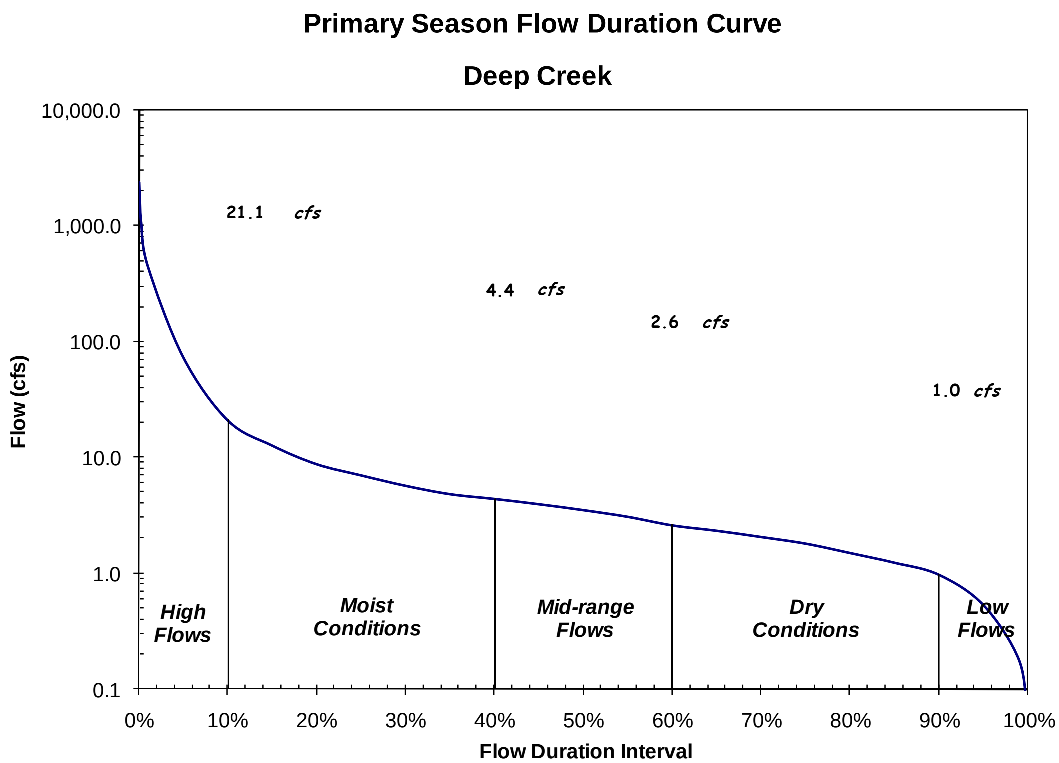


Figure 4-4

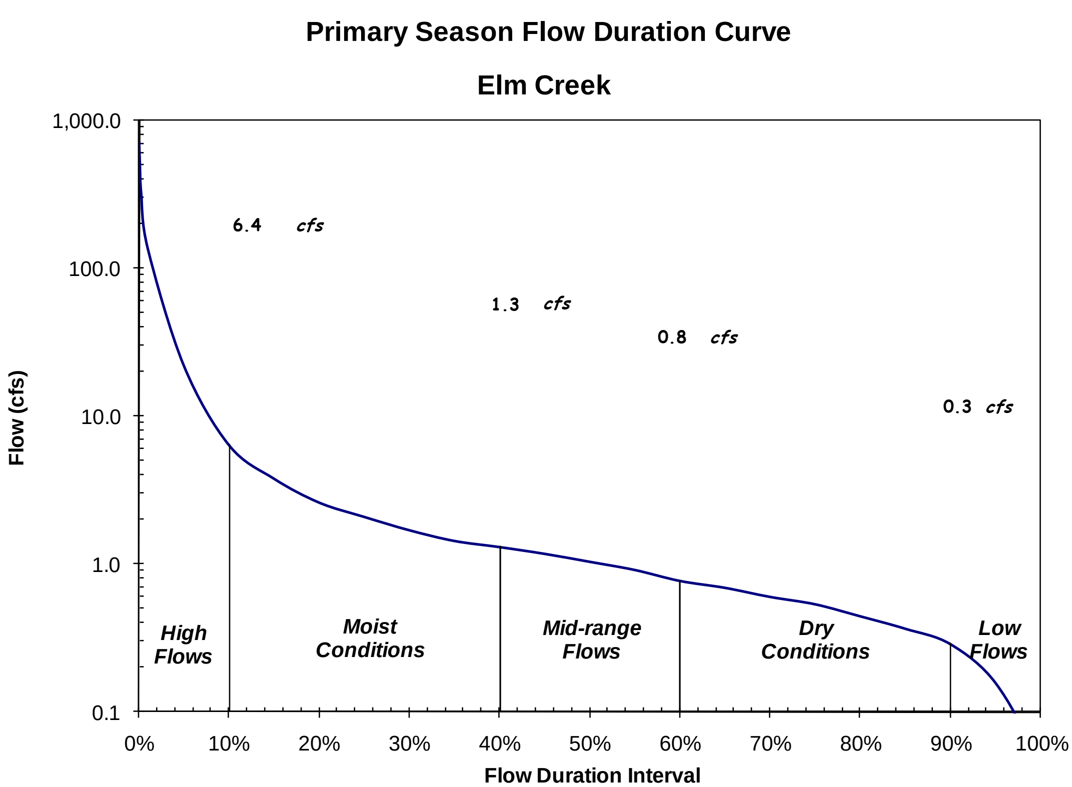


Figure 4-5

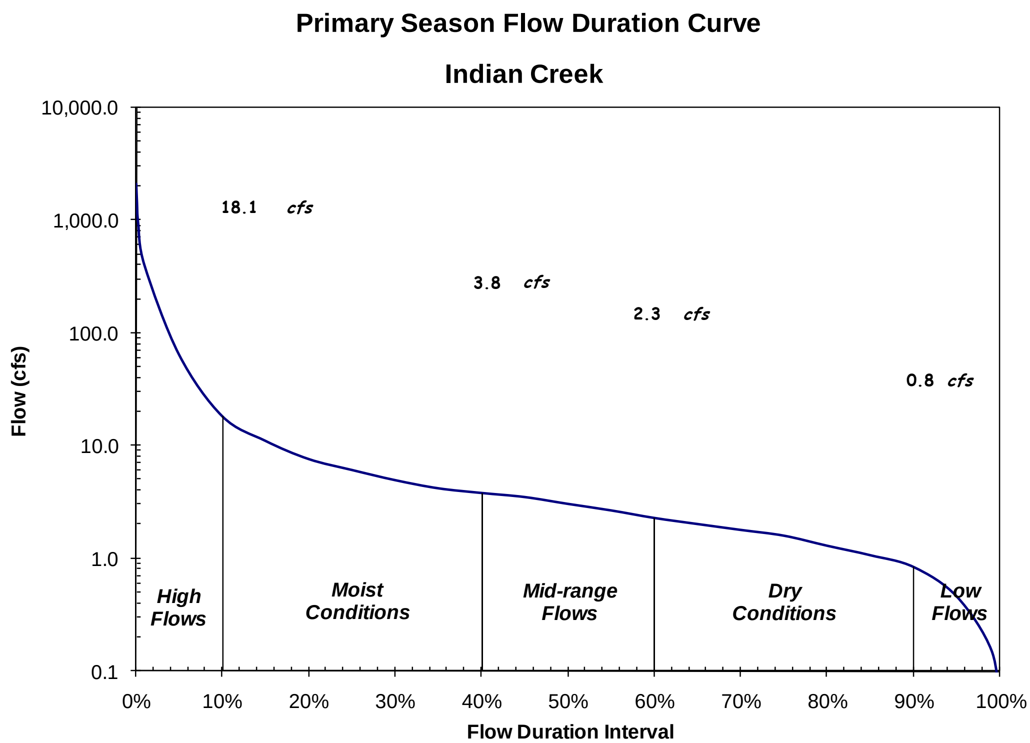


Figure 4-6

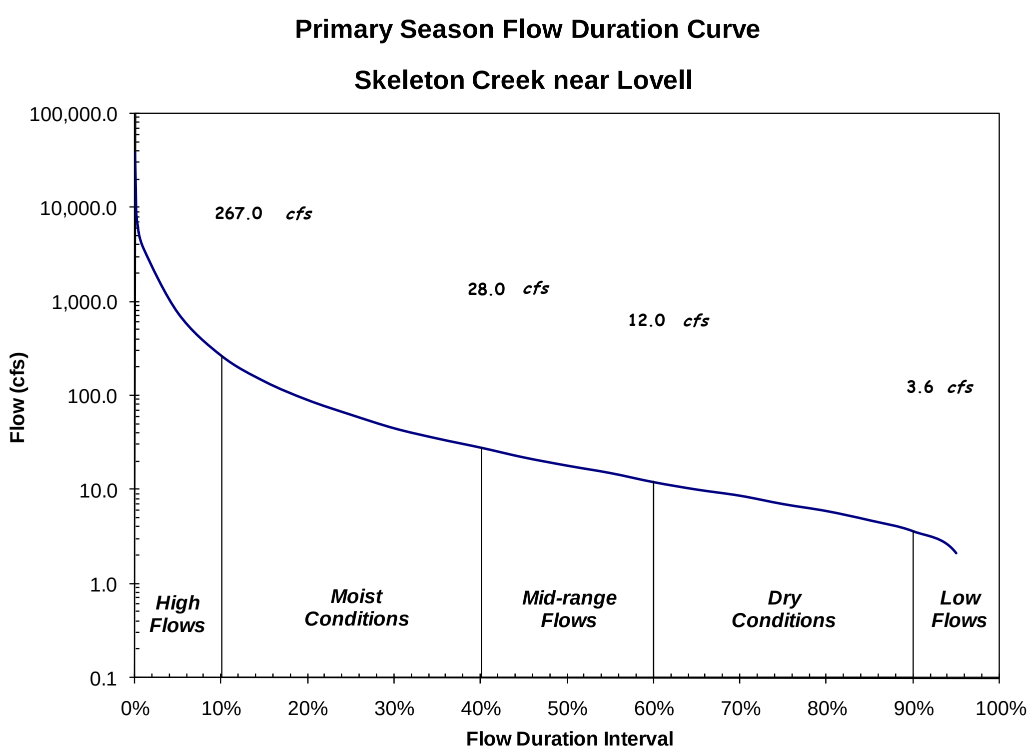


Figure 4-7

Primary Season Flow Duration Curve

Cottonwood Creek

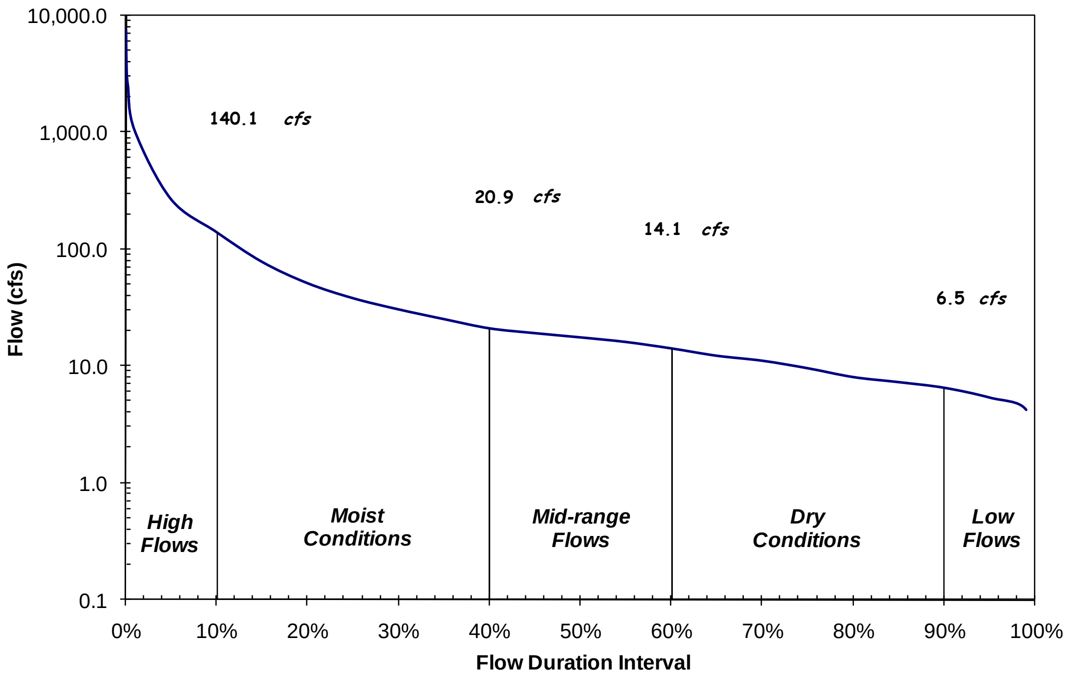


Figure 4-8

Primary Season Flow Duration Curve

Deer Creek

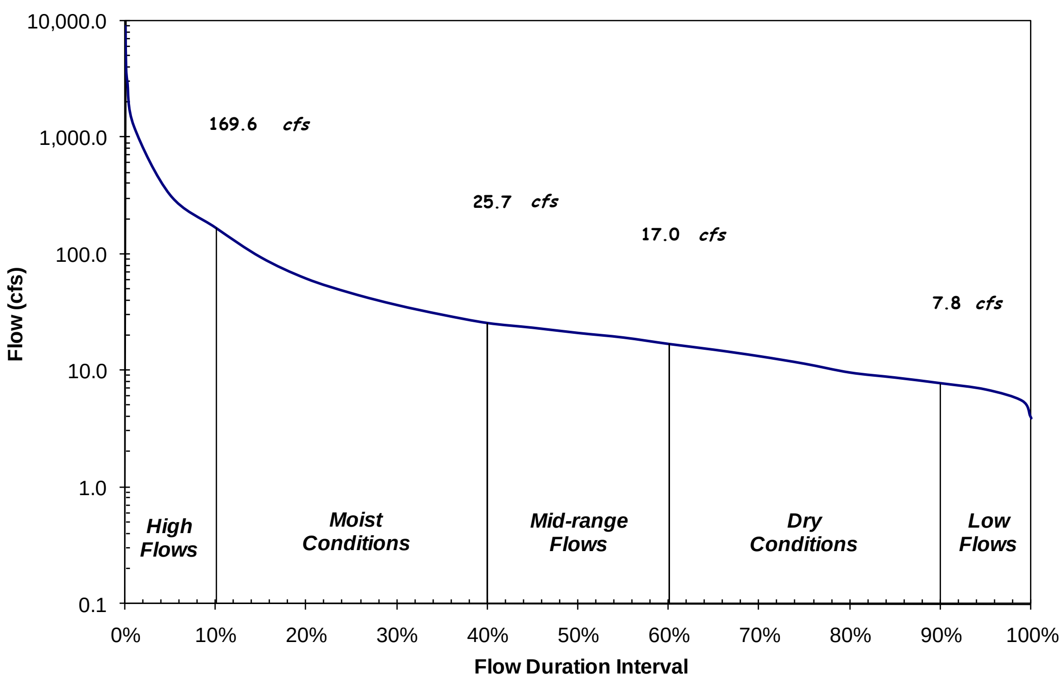


Figure 4-9

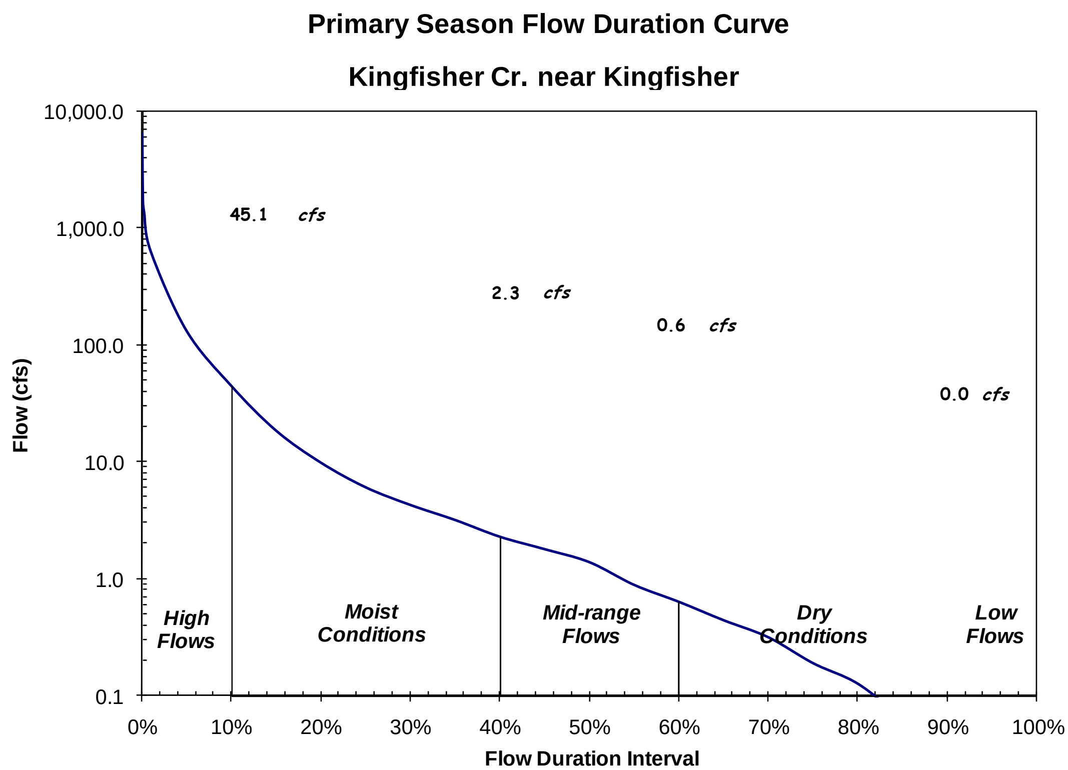


Figure 4-10

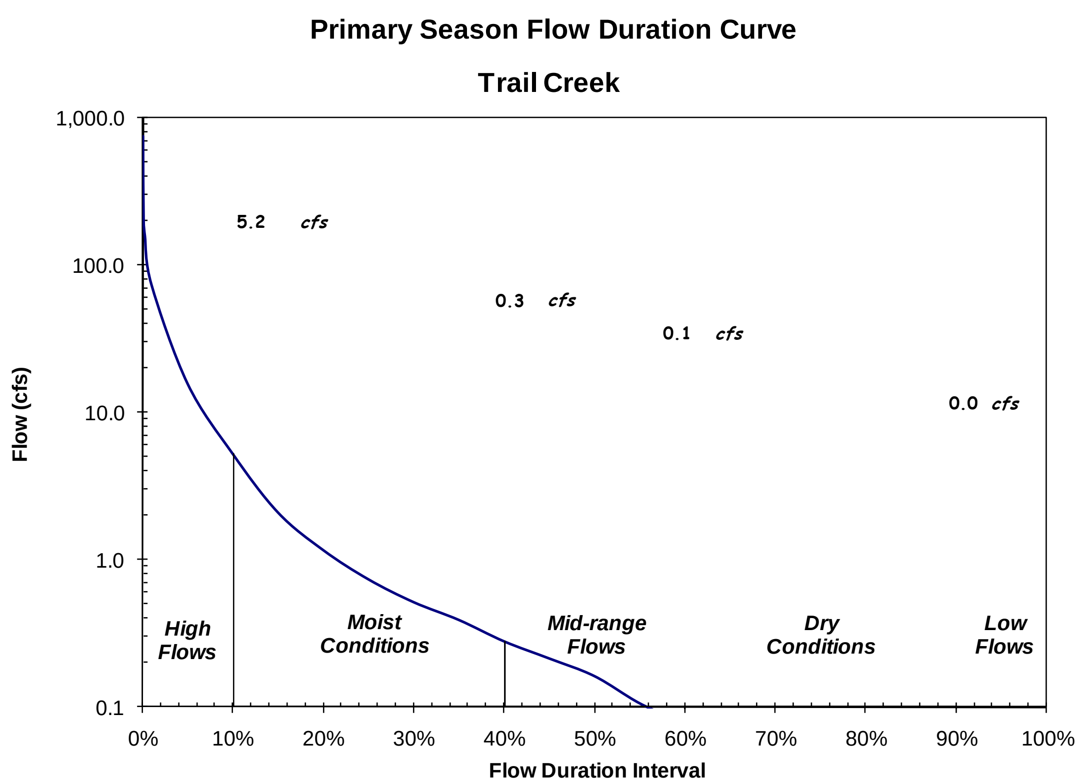


Figure 4-11

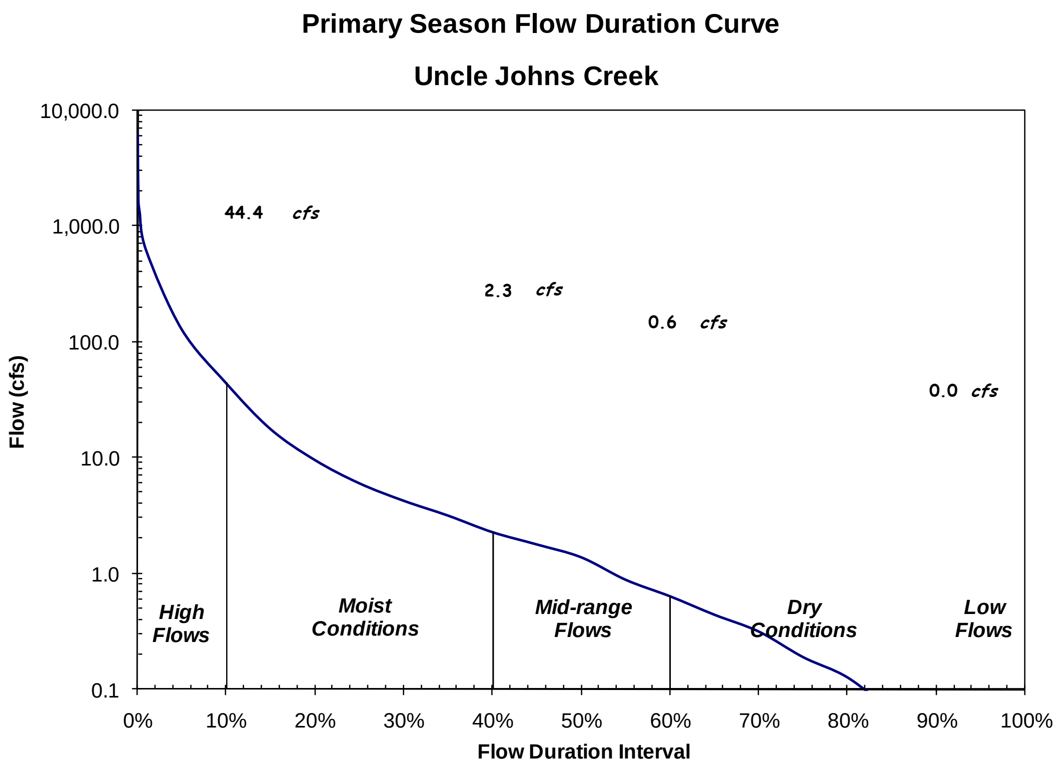
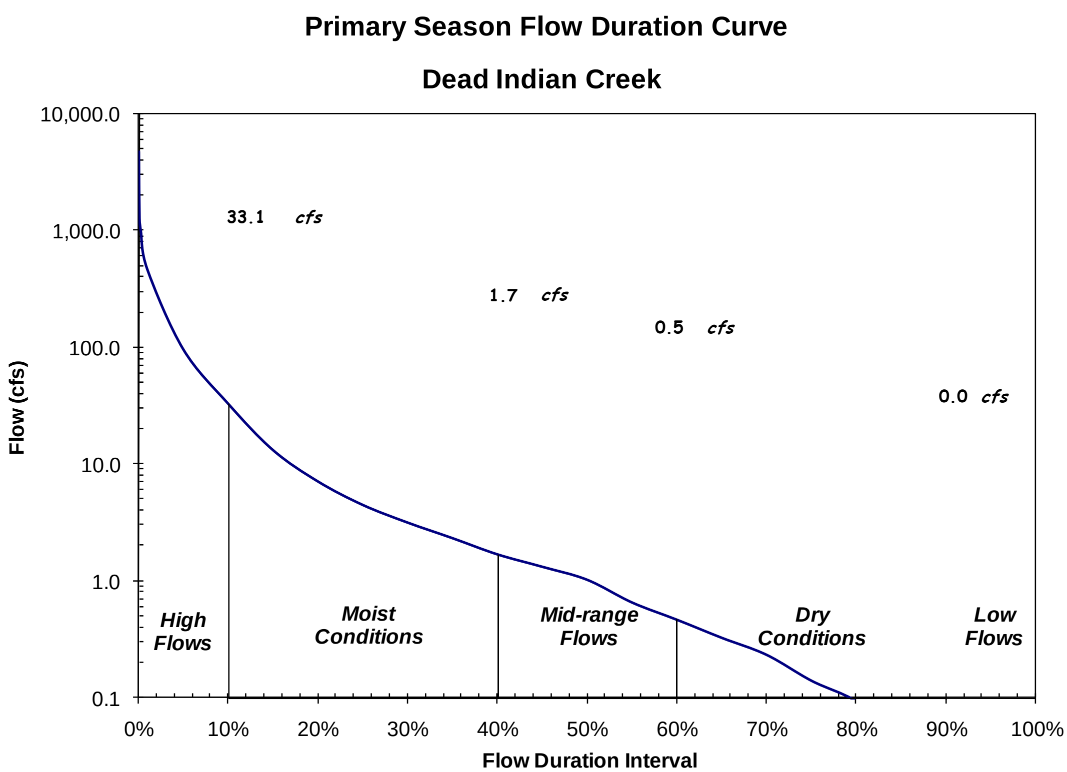


Figure 4-12



Some instantaneous flow measurements were available from various agencies. These were combined with the daily average flows and used in calculating flow percentiles. They were also matched to bacteria grab measurements collected at the same site and time. When available, these instantaneous flow measurements were used in lieu of the daily average flow to calculate instantaneous bacteria loads.

4.3 Estimating Current Point and Nonpoint Loading

Another key step in the use of LDCs for TMDL development is the estimation of existing bacteria loading from point and nonpoint sources and the display of this loading in relation to the TMDL. In Oklahoma, WWTPs that discharge treated sanitary wastewater must meet the state WQSs for fecal bacteria at the point of discharge. However, for TMDL analysis it is necessary to understand the relative contribution of WWTPs to the overall pollutant loading and its general compliance with required effluent limits. The monthly bacteria load for continuous point source dischargers is estimated by multiplying the monthly average flow rates by the monthly geometric mean using a conversion factor. The current pollutant loading from each permitted point source discharge is calculated using the equation below.

*Point Source Loading = monthly average flow rates (mgd) * geometric mean of corresponding fecal coliform concentration * unit conversion factor*

Where:

unit conversion factor = 37,854,120 100-ml/million gallons (mg)

It is difficult to estimate current nonpoint loading due to lack of specific water quality and flow information that would assist in estimating the relative proportion of non-specific sources within the watershed. Therefore, existing in-stream loads minus the point source loads were used as an estimate for nonpoint loading.

4.4 Development of TMDLs Using Load Duration Curves

The final step in the TMDL calculation process involves a group of additional computations derived from the preparation of LDCs. These computations are necessary to derive a PRG (which is one method of presenting how much bacteria loading must be reduced to meet WQSs in the impaired watershed).

Step 1: Generate Bacteria LDCs. LDCs are similar in appearance to flow duration curves; however, the ordinate is expressed in terms of a bacteria load in cfu/day. The curve represents the single sample water quality criterion for fecal coliform (400 cfu/100 mL), *E. coli* (406 cfu/100 mL), or Enterococci (108 cfu/100 mL) expressed in terms of a load through multiplication by the continuum of flows historically observed at this site. The basic steps to generating an LDC involve:

- obtaining daily flow data for the site of interest from the USGS;
- sorting the flow data and calculating flow exceedance percentiles for the time period and season of interest;
- obtaining the water quality data from the primary contact recreation season (May 1 through September 30);
- matching the water quality observations with the flow data from the same date;

- display a curve on a plot that represents the allowable load multiplied by the actual or estimated flow by the WQS for each respective indicator;
- multiplying the flow by the water quality parameter concentration to calculate daily loads; then
- plotting the flow exceedance percentiles and daily load observations in a load duration plot.

The culmination of these steps is expressed in the following formula, which is displayed on the LDC as the TMDL curve:

*TMDL (cfu/day) = WQS * flow (cfs) * unit conversion factor*

Where: WQS = 400 cfu /100 ml (Fecal coliform); 406 cfu/100 ml (E. coli); or 108 cfu/100 ml (Enterococci)

*unit conversion factor = 24,465,525 ml*s / ft3*day*

The flow exceedance frequency (x-value of each point) is obtained by looking up the historical exceedance frequency of the measured or estimated flow; in other words, the percent of historical observations that equal or exceed the measured or estimated flow. Historical observations of bacteria concentration are paired with flow data and are plotted on the LDC. The fecal coliform load (or the y-value of each point) is calculated by multiplying the fecal coliform concentration (cfu/100 mL) by the instantaneous flow (cubic feet per second [cfs]) at the same site and time, with appropriate volumetric and time unit conversions. Fecal coliform/*E. coli*/Enterococci loads representing exceedance of water quality criteria fall above the water quality criterion line.

Only those flows and water quality samples observed in the months comprising the primary contact recreation season are used to generate the LDCs. It is inappropriate to compare single sample bacteria observations and instantaneous or daily flow durations to a 30-day geometric mean water quality criterion in the LDC.

As noted earlier, runoff has a strong influence on loading of nonpoint pollution. Yet flows do not always correspond directly to local runoff; high flows may occur in dry weather and runoff influence may be observed with low or moderate flows.

Step 2: Develop LDCs with MOS. An LDC depicting slightly lower estimates than the TMDL is developed to represent the TMDL with MOS. The MOS may be defined explicitly or implicitly. A typical explicit approach would reserve some fraction of the TMDL (*e.g.,* 10%) as the MOS. In an implicit approach, conservative assumptions used in developing the TMDL are relied upon to provide an MOS to assure that WQSs are attained.

For the TMDLs in this report, an explicit MOS of 10 percent of the TMDL value (10% of the instantaneous water quality criterion) has been selected.

Step 3: Calculate WLA. As previously stated, the pollutant LA for point sources is defined by the WLA. A point source can be either a wastewater (continuous) or stormwater (MS4) discharge. Stormwater point sources are typically associated with urban and industrialized areas, and recent USEPA guidance includes NPDES-permitted stormwater discharges as point source discharges and, therefore, part of the WLA.

The LDC approach recognizes that the assimilative capacity of a waterbody depends on the flow, and that maximum allowable loading will vary with flow condition. TMDLs can be expressed in terms of maximum allowable concentrations, or as different maximum loads allowable under different flow conditions, rather than single maximum load values. This concentration-based approach meets the requirements of 40 CFR, 130.2(i) for expressing TMDLs "in terms of mass per time, toxicity, or other appropriate measures" and is consistent with USEPA's Protocol for Developing Pathogen TMDLs (USEPA 2001).

WLA for WWTP. WLAs may be set to zero for watersheds with no existing or planned continuous permitted point sources. For watersheds with permitted point sources, WLAs may be derived from NPDES permit limits. A WLA may be calculated for each active NPDES wastewater discharger using a mass balance approach as shown in the equation below. The permitted average flow rate used for each point source discharge and the water quality criterion concentration are used to estimate the WLA for each wastewater facility. All WLA values for each NPDES wastewater discharger are then summed to represent the total WLA for the watershed.

*WLA = WQS * flow * unit conversion factor (#/day)*

Where:

Where: WQS = 200 cfu /100 ml (Fecal coliform); 126 cfu/100 ml (E. coli); or 33 cfu/100 ml (Enterococci)

flow (10^6 gal/day) = permitted flow

unit conversion factor = 37,854,120-10^6gal/day

Step 4: Calculate LA and WLA for MS4s. Given the lack of data and the variability of storm events and discharges from storm sewer system discharges, it is difficult to establish numeric limits on stormwater discharges that accurately address projected loadings. As a result, EPA regulations and guidance recommend expressing NPDES permit limits for MS4s as BMPs.

LAs can be calculated under different flow conditions as the water quality target load minus the WLA. The LA is represented by the area under the LDC but above the WLA. The LA at any particular flow exceedance is calculated as shown in the equation below.

LA = TMDL - WLA_WWTP - WLA_MS4 - MOS

WLA for MS4s. If there are no permitted MS4s in the study area, WLA_MS4 is set to zero. When there are permitted MS4s in the watershed, we can first calculate the sum of LA + WLA_MS4 using the above formula, then separate WLA for MS4s from the sum based on the percentage of a watershed that is under a MS4 jurisdiction. This WLA for MS4s may not be the total load allocated for permitted MS4s unless the whole MS4 area is located within the study watershed boundary. However, in most case the study watershed intersects only a portion of the permitted MS4 coverage areas.

Step 5: Estimate WLA Load Reduction. The WLA load reduction was not calculated as it was assumed that continuous dischargers (NPDES-permitted WWTPs) are adequately regulated under existing permits to achieve water quality standards at the end-of-pipe and, therefore, no WLA reduction would be required. All SSOs are considered unpermitted discharges under State statute and DEQ regulations. For any MS4s that are located within a watershed requiring a TMDL the load reduction will be equal to the PRG established for the overall watershed.

Step 6: Estimate LA Load Reduction. After existing loading estimates are computed for each bacteria indicator, nonpoint load reduction estimates for each stream segment are calculated by using the difference between estimated existing loading and the allowable load expressed by the LDC (TMDL-MOS). This difference is expressed as the overall percent reduction goal for the impaired waterbody. For fecal coliform the PRG which ensures that no more than 25 percent of the samples exceed the TMDL based on the instantaneous criteria allocates the loads in manner that is also protective of the geometric mean criterion. For *E. coli* and Enterococci, because WQ standards are considered to be met if 1) either the geometric mean of all data is less than the geometric mean criteria, or 2) no sample exceeds the instantaneous criteria, the TMDL PRG will be the lesser of that required to meet the geometric mean or instantaneous criteria.

SECTION 5
TMDL CALCULATIONS

5.1 Estimated Loading and Critical Conditions

USEPA regulations at 40 CFR 130.7(c) (1) require TMDLs to take into account critical conditions for stream flow, loading, and all applicable water quality standards. To accomplish this, available in-stream WQM data were evaluated with respect to flows and magnitude of water quality criteria exceedance using LDCs.

To calculate the bacteria load at the WQS, the flow rate at each flow exceedance percentile is multiplied by a unit conversion factor ($24{,}465{,}525\ ml*s / ft^3*day$) and the criterion specific to each bacteria indicator. This calculation produces the maximum bacteria load in the stream without exceeding the instantaneous standard over the range of flow conditions. The x-axis indicates the flow exceedance percentile, while the y-axis is expressed in terms of a bacteria load.

To estimate existing loading, bacteria observations for the primary contact recreation season (May 1st through September 30th) from 1999 to 2003 are paired with the flows measured or estimated in that segment on the same date. Pollutant loads are then calculated by multiplying the measured bacteria concentration by the flow rate and a unit conversion factor of $24{,}465{,}525\ ml*s / ft^3*day$. The associated flow exceedance percentile is then matched with the measured flow from the tables provided in Appendix C. The observed bacteria loads are then added to the LDC plot as points. These points represent individual ambient water quality samples of bacteria. Points above the LDC indicate the bacteria instantaneous standard was exceeded at the time of sampling. Conversely, points under the LDC indicate the sample met the WQS.

The LDC approach recognizes that the assimilative capacity of a waterbody depends on the flow, and that maximum allowable loading varies with flow condition. Existing loading, and load reductions required to meet the TMDL water quality target can also be calculated under different flow conditions. The difference between existing loading and the water quality target is used to calculate the loading reductions required. Percent reduction goals are calculated for each watershed and bacterial indicator species. This is because for the PBCR use to be supported, criteria for each bacteria indicator must be met in each impaired waterbody.

Table 5-1 presents the percent reductions necessary for each bacteria indicator in each of the impaired waterbodies in the Study Area. Attainment of WQS in response to TMDL implementation will be based on results measured at each of the stream segments. The appropriate PRG for each bacteria indicator for each waterbody in Table 5-1 is denoted by the bold text. The PRGs range from 28 to 95 percent. No PRG is set for Chisholm Creek as new assessment of monitoring data found no bacteria impairment in the waterbody.

Table 5-1 TMDL Percent Reductions Required to Meet Water Quality Standards for Impaired Waterbodies in the Study Area

WQM Station	Waterbody ID	Waterbody Name	Percent Reduction Required				
			FC	EC		ENT	
			Instantaneous	Instantaneous	Geo-mean	Instantaneous	Geo-mean
OK620910010010-001AT	OK620910010010_00	Cimarron River				97%	**51%**
OK620910-02-0040C	OK620910020040_00	Cooper Creek		98%	**17%**	99%	**87%**
OK620910-02-0250C	OK620910020250_00	Deep Creek		83%	**48%**	95%	**86%**
OK620910-02-0270G	OK620910020270_00	Elm Creek	**40%**				
OK620910-02-0310C	OK620910020310_00	Indian Creek		48%	**22%**	89.4%	**88.9%**
OK620910030010-001AT OK620910-03-0010F OK620910-03-0010S	OK620910030010_00	Skeleton Creek	**49%**	97%	**27%**	99%	**90%**
OK620910-04-0010G	OK620910040010_20	Cottonwood Creek	**28%**				
OK620910-04-0100G	OK620910040100_00	Chisholm Creek					
OK620910-04-0120B	OK620910040120_00	Deer Creek	**72%**				
OK620910-05-0010G OK620910-05-0010J	OK620910050010_00	Kingfisher Creek	**40%**	82%	**58%**	95%	**93%**
OK620910-05-0020G	OK620910050020_00	Trail Creek	**55%**				
OK620910-05-0030C	OK620910050030_00	Uncle Johns Creek		82%	**34%**	97%	**94%**
OK620910-05-0080D	OK620910050080_00	Dead Indian Creek		97%	**73%**	99%	**95%**

Load duration curves (LDCs) for each impaired waterbody are shown in Figures 5-1 through 5-12. While some waterbodies may be listed for multiple bacterial indicators, only one LDC for each waterbody is presented in Figures 5-1 through 5-12. The LDCs for the other bacterial indicators that require TMDLs are presented in Subsection 5.7 of this report.

The LDC for Cimarron River segment OK620910010010_00 (Figure 5-1) is based on Enterococcus bacteria measurements during the primary contact recreation season at WQM station OK620910010010-001AT. The LDC indicates that Enterococcus levels exceed the instantaneous water quality criteria during dry and moist conditions. Exceedances during moist conditions are thought to be due to non-point sources. The exceedances found during dry weather conditions indicate some level of pollution may be due to failing onsite systems or direct deposition of animal manure.

The LDC for Cooper Creek (Figure 5-2) is based on Enterococcus bacteria measurements during the primary contact recreation season at WQM station OK620910-02-0040C. The LDC indicates that Enterococcus levels exceed the instantaneous water quality criteria under a wide range of flows. Exceedances during moist to high flow conditions are thought to be due to non-point sources. The exceedances found during dry and low flow conditions indicate some level of pollution may be due to failing onsite systems or direct deposition of animal manure.

The LDC for Deep Creek (Figure 5-3) is based on Enterococcus bacteria measurements during primary contact recreation season at WQM station OK620910-02-0250C. The LDC indicates that Enterococcus levels exceed the instantaneous water quality criteria under a variety of hydrologic conditions. Exceedances during moist to high flow conditions are thought to be due to non-point sources. The exceedances found during dry and low flow conditions indicate some level of pollution may be due to failing onsite systems or direct deposition of animal manure.

The LDC for Elm Creek (Figure 5-4) is based on fecal coliform bacteria measurements during the primary contact recreation season at WQM station OK620910-02-0270G. The LDC indicates that fecal coliform levels exceed the instantaneous water quality criteria primarily under dry and low flow conditions. Since there are no point sources in the watershed, pollution may be due to failing onsite systems or direct deposition of animal manure.

The LDC for Indian Creek (Figure 5-5) is based on Enterococcus bacteria measurements during primary contact recreation season at WQM station OK620910-02-0310G. The LDC indicates that Enterococcus levels exceed the instantaneous water quality criteria predominantly during high flow and moist conditions, indicative of nonpoint sources.

The LDC for Skeleton Creek (Figure 5-6) is based on Enterococcus bacteria measurements during primary contact recreation season at WQM stations OK620910030010-001AT, OK620910-03-0010F and OK620910-03-0010S. The LDC indicates that Enterococcus levels sometimes exceed the instantaneous water quality criteria during all flow conditions, and may indicate water quality impairments due to a combination of point and nonpoint sources.

The LDC for Cottonwood Creek (Figure 5-7) is based on fecal coliform bacteria measurements during primary contact recreation season at WQM station OK620910-04-0010G. The LDC indicates that fecal coliform levels exceed the instantaneous water quality criteria primarily under dry and low flow conditions. Since there are no point sources in the watershed, pollution may be due to failing onsite systems or direct deposition of animal manure.

The LDC for Deer Creek (Figure 5-8) is based on fecal coliform bacteria measurements during the primary contact recreation season at WQM station OK620910-04-0120B. Due to the substantial flow contribution (permitted flow of 15 MGD or 23.2 cfs) from the Oklahoma City Deer Creek treatment facility, the LDC for Deer Creek is based on a 23.2 cfs increase across the entire curve over the flow duration curve (Figure 4-8). The LDC indicates that fecal coliform levels exceed the instantaneous water quality criteria under mid to high flow conditions, indicative of primarily nonpoint sources and some point sources.

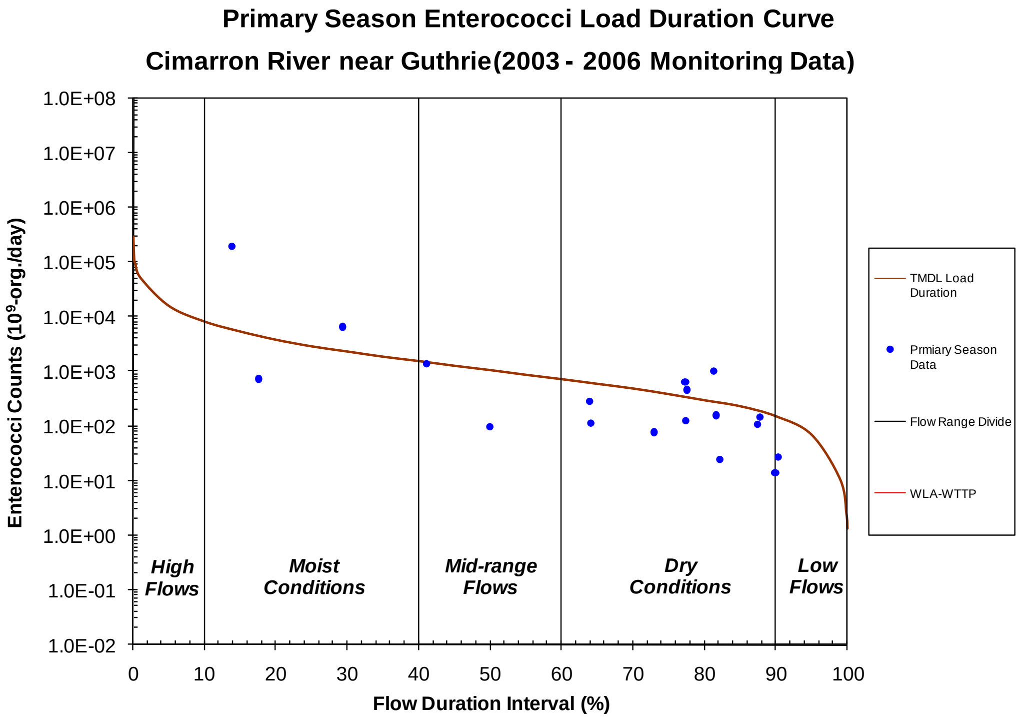
The LDC for Kingfisher Creek (Figure 5-9) is based on Enterococcus measurements during the primary contact recreation season at WQM stations OK620910-05-0020G and OK620910-05-0020J. Due to the substantial flow contribution (permitted flow of 0.8 MGD or 1.24 cfs) from the Kingfisher treatment facility, especially during dry and low conditions, the LDC for Kingfisher Creek is based on a 1.24 cfs increase across the entire curve over the flow duration curve (Figure 4-9). The LDC indicates that levels exceed the instantaneous water quality criteria under mid to high flow conditions, indicative of a combination of point and nonpoint sources.

The LDC for Trail Creek (Figure 5-10) is based on fecal coliform bacteria measurements during the primary contact recreation season at WQM station OK620910-05-0020G. The LDC indicates that fecal coliform levels exceed the instantaneous water quality criteria from dry to high flow conditions. Since there are no point sources in the watershed, exceedances during moist to high flow conditions are thought to be due to non-point sources. The exceedances found during dry and low flow conditions indicate some level of pollution may be due to failing onsite systems or direct deposition of animal manure.

The LDC for Uncle Johns Creek (Figure 5-11) is based on Enterococcus measurements during the primary contact recreation season at WQM station OK620910-05-0030C. The LDC indicates that Enterococcus levels exceed the instantaneous water quality criteria from dry to high flow conditions. Since there are no point sources in the watershed, exceedances during moist to high flow conditions are thought to be due to non-point sources. The exceedances found during dry and low flow conditions indicate some level of pollution may be due to failing onsite systems or direct deposition of animal manure.

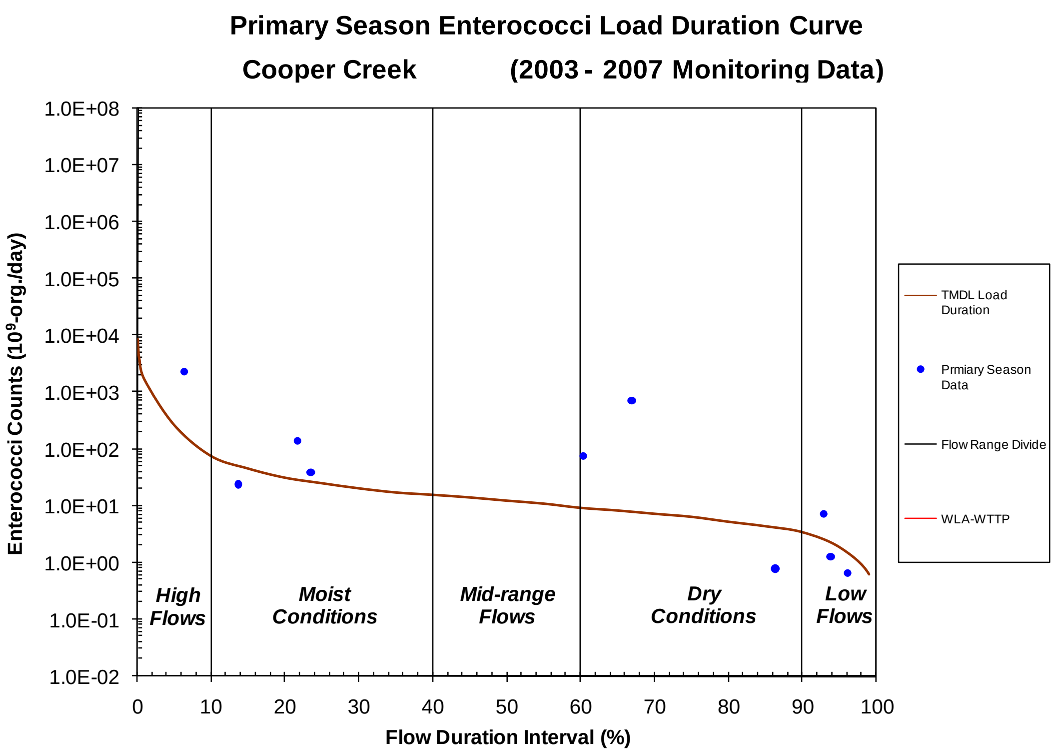
The LDC for Dead Indian Creek (Figure 5-12) is based on Enterococcus measurements during the primary contact recreation season at WQM station OK620910-05-0080D. The LDC indicates that Enterococcus levels exceed the instantaneous water quality criteria from dry to high flow conditions. Since there are no point sources in the watershed, exceedances during moist to high flow conditions are thought to be due to non-point sources. The exceedances found during dry and low flow conditions indicate some level of pollution may be due to failing onsite systems or direct deposition of animal manure.

Figure 5-1



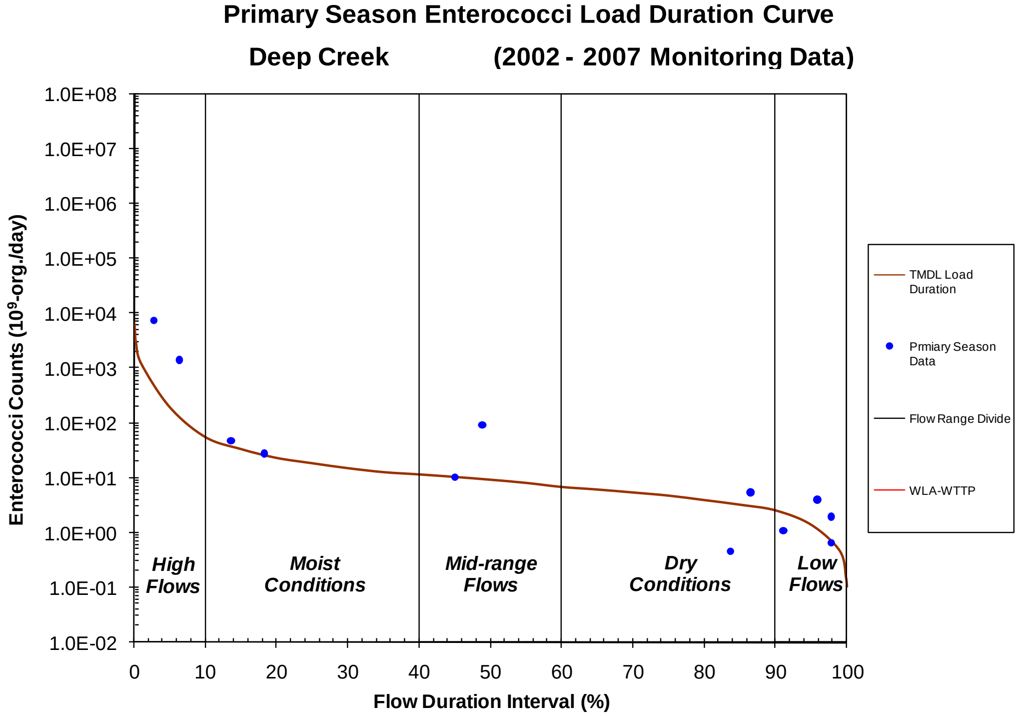
* There is no wasteload allocation for this waterbody

Figure 5-2



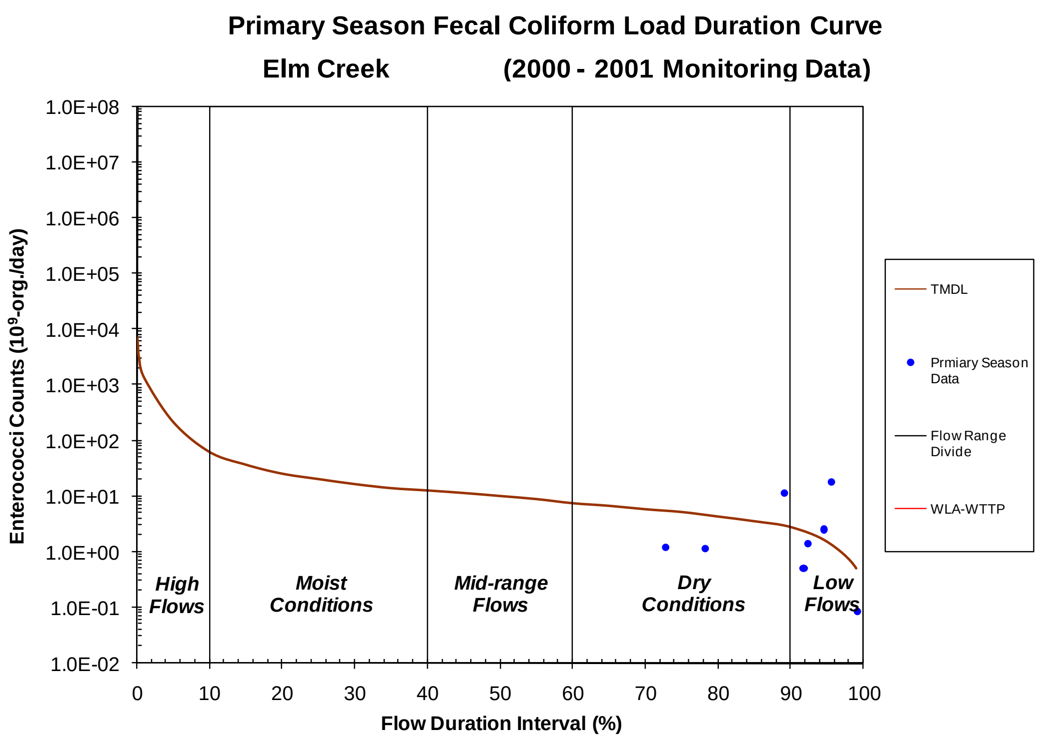
* There is no wasteload allocation for this waterbody

Figure 5-3



* There is no wasteload allocation for this waterbody

Figure 5-4



* There is no wasteload allocation for this waterbody

Figure 5-5

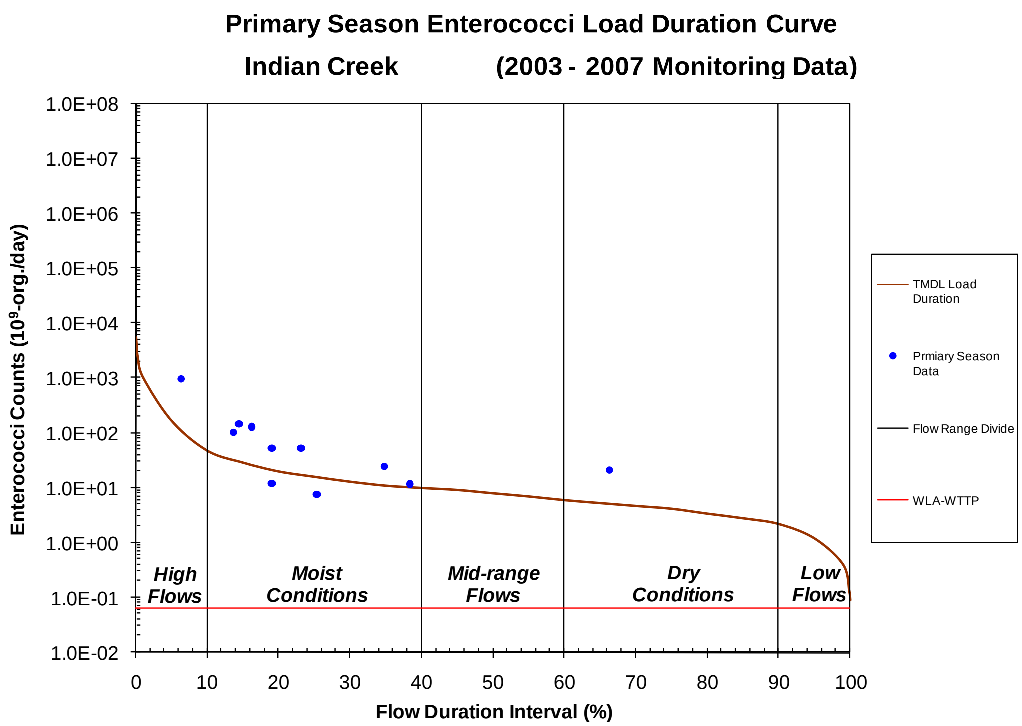


Figure 5-6

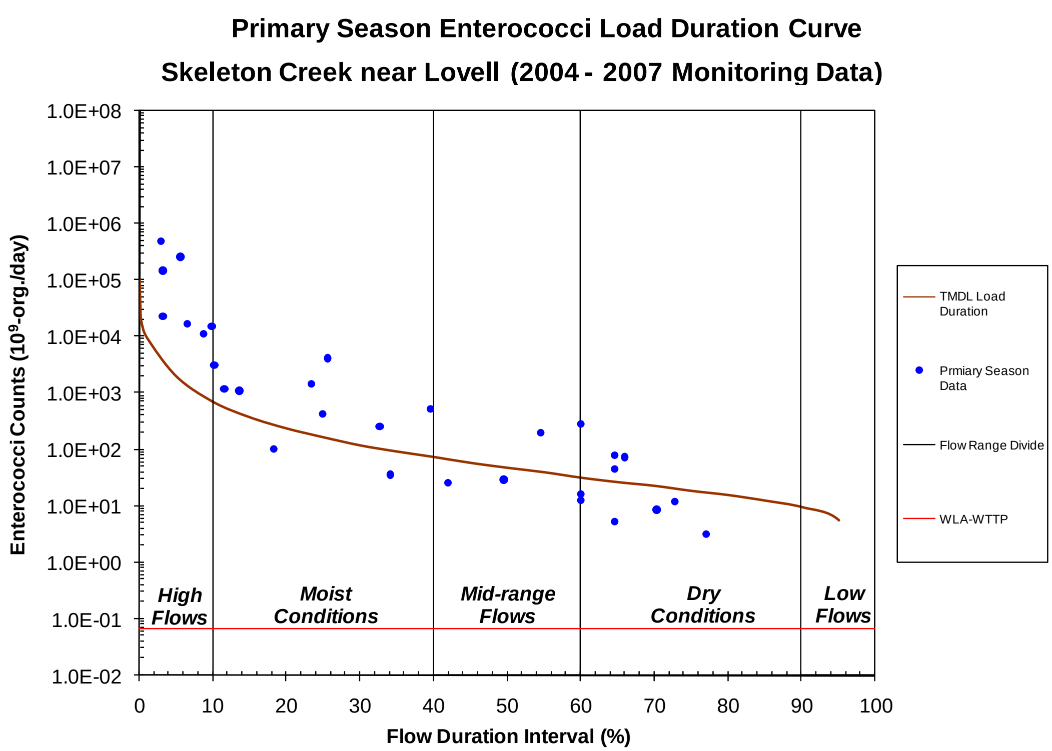
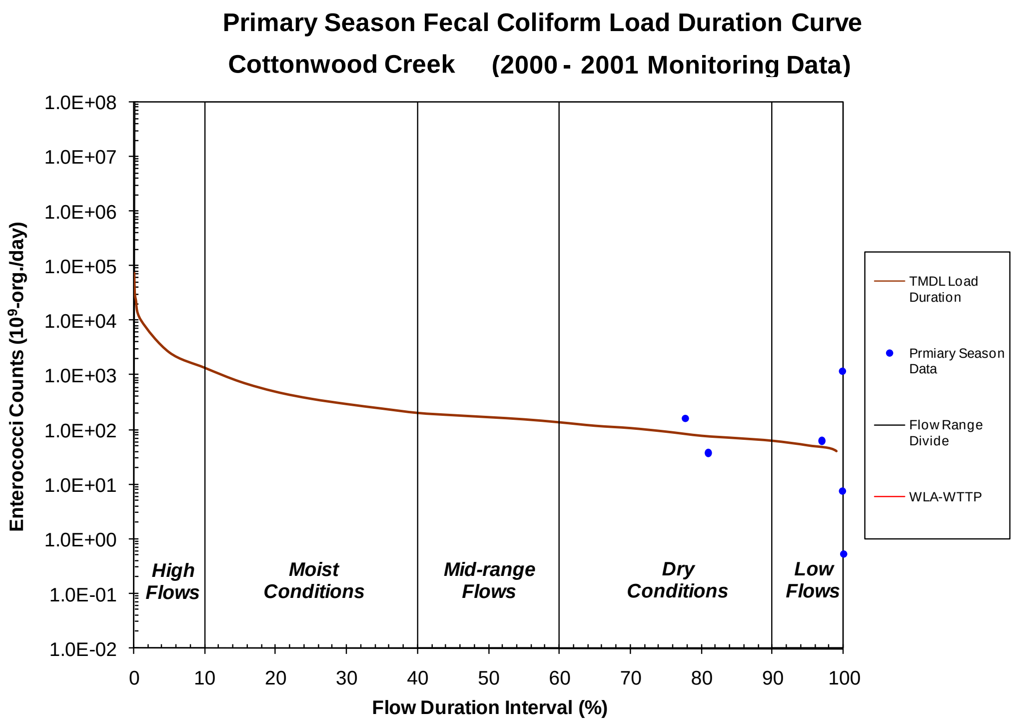


Figure 5-7



*There is no wasteload allocation for this waterbody

Figure 5-8

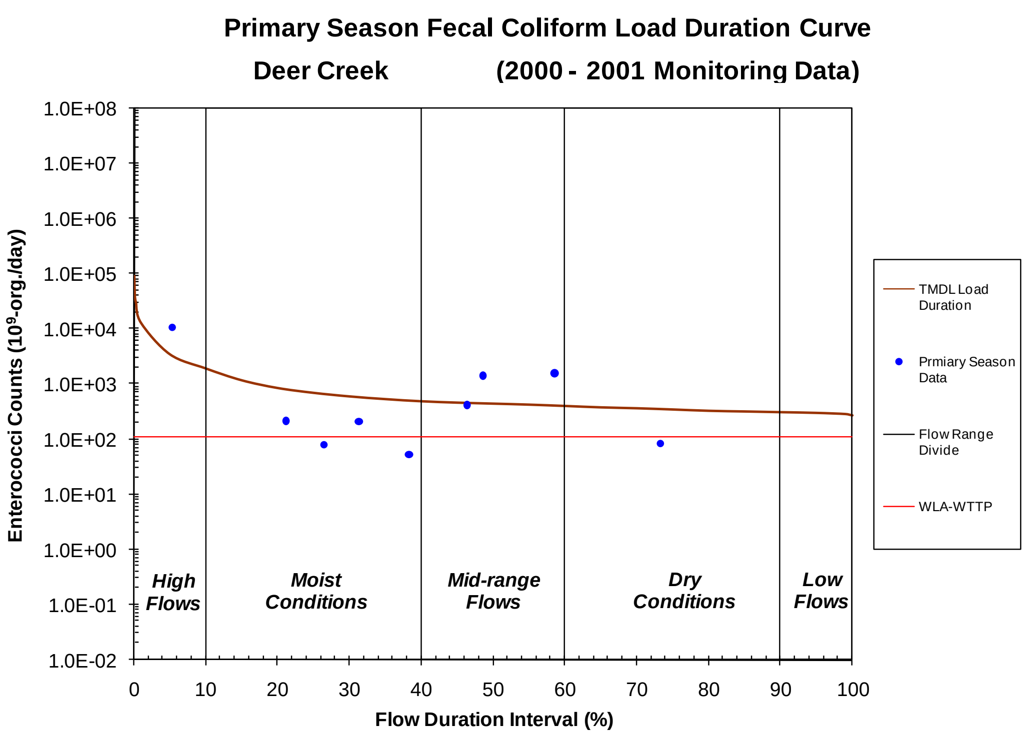


Figure 5-9

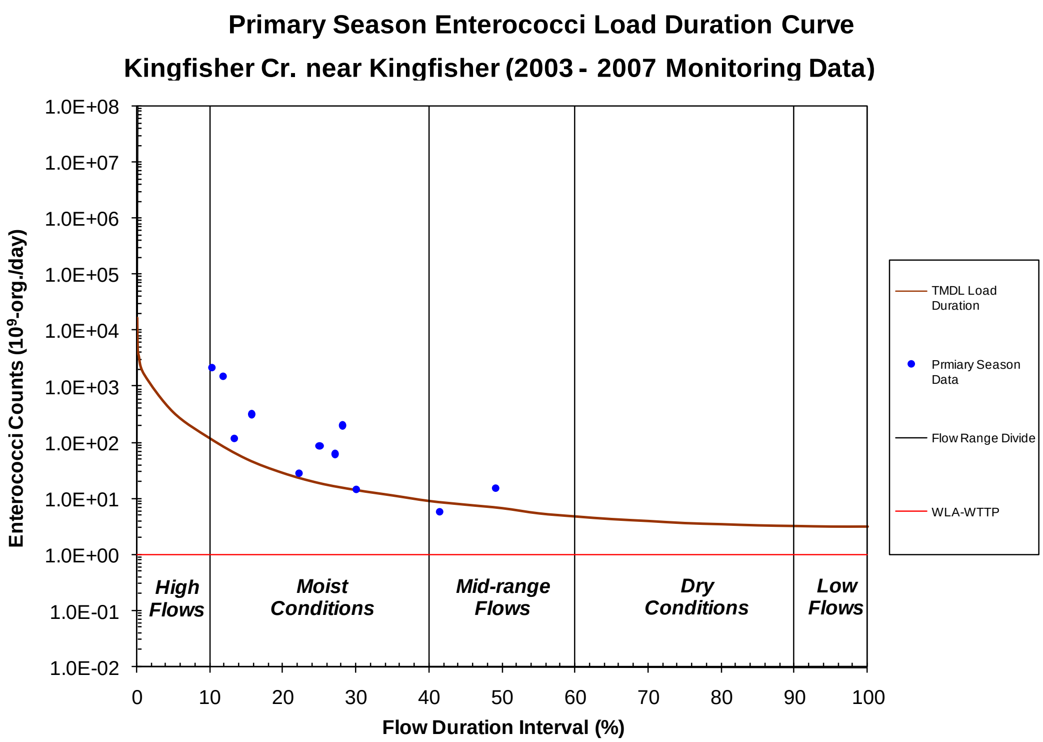
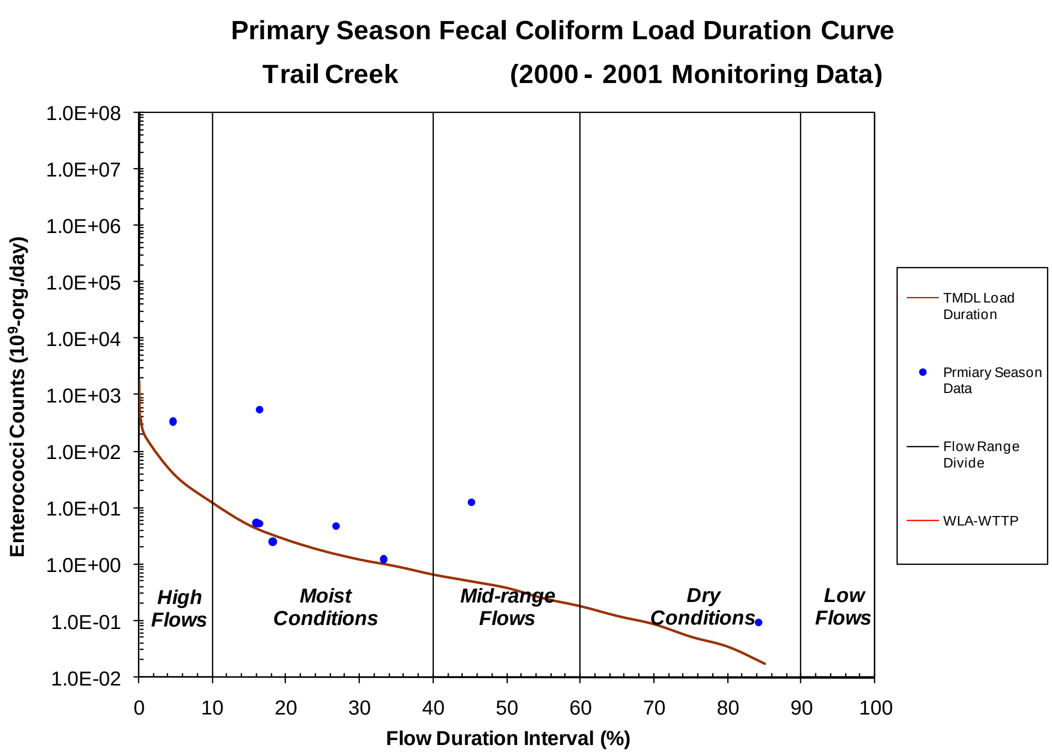
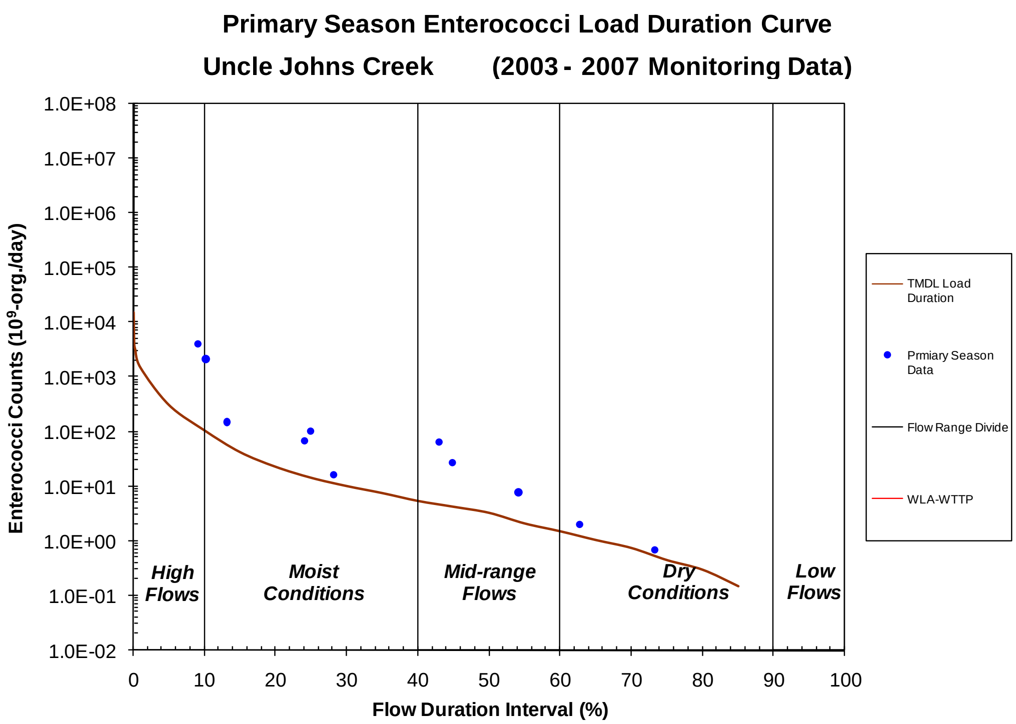


Figure 5-10



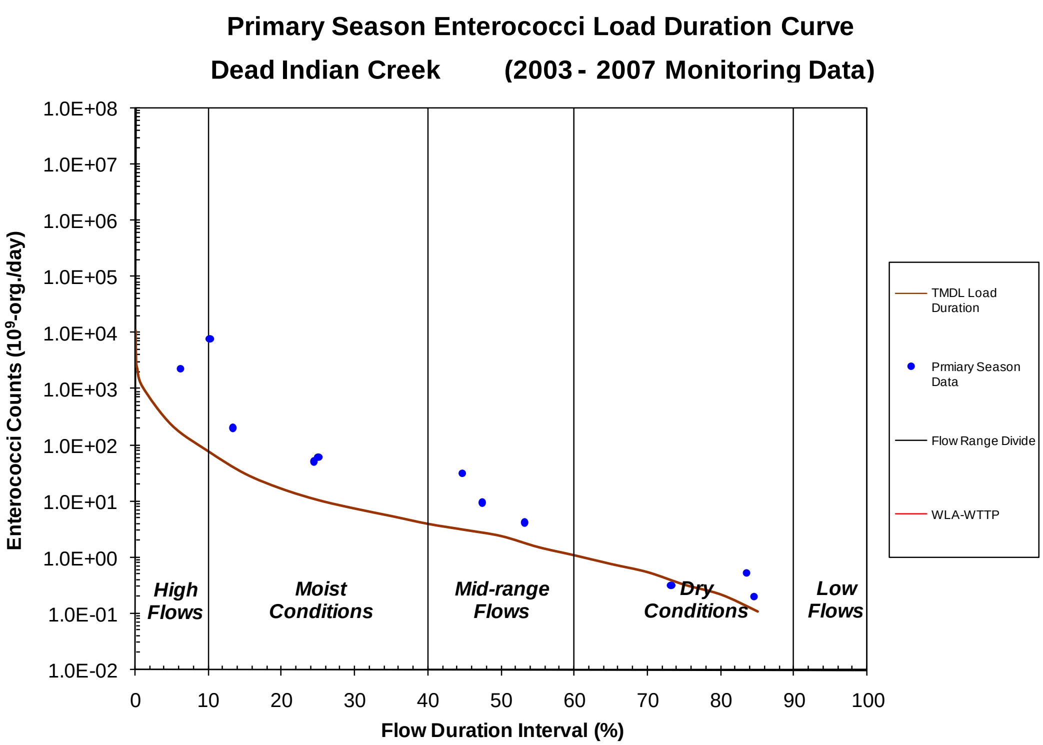
* There is no wasteload allocation for this waterbody

Figure 5-11



* There is no wasteload allocation for this waterbody

Figure 5-12



* There is no wasteload allocation for this waterbody.

5.2 Wasteload Allocation

NPDES-permitted facilities are allocated a daily wasteload calculated as their permitted daily average discharge flow rate multiplied by the in-stream geometric mean water quality criterion. In other words, the facilities are required to meet in-stream criteria in their discharge. Table 5-2 summarizes the WLA for the NPDES-permitted facilities within the Study Area. The WLA for each facility is derived from the following equation:

WLA = WQS * flow * unit conversion factor (#/day)

Where:

WQS = 33, 200, and 126 cfu/100ml for Enterococci, fecal coliform, and E. coli respectively

flow (10^6 gal/day) = permitted flow

unit conversion factor = 37,854,120-10^6gal/day

When multiple NPDES facilities occur within a watershed, individual WLAs are summed and the total WLA for continuous point sources is included in the TMDL calculation for the corresponding waterbody. When there are no NPDES WWTPs discharging into the contributing watershed of a stream segment, then the WLA is zero. Compliance with the WLA will be achieved by adhering to the fecal coliform limits and disinfection requirements of NPDES permits. Table 5-2 indicates which point source dischargers within the Study Area currently have a disinfection requirement in their permit. Certain facilities that utilize lagoons for treatment have not been required to provide disinfection since storage time and exposure to ultraviolet radiation from sunlight should reduce bacteria levels. In the future, all point source dischargers which are assigned a wasteload allocation but do not currently have a bacteria limit in their permit will receive a permit limit consistent with the wasteload allocation as their permits are reissued. Regardless of the magnitude of the WLA calculated in these TMDLs, future new discharges of bacteria or increased bacteria load from existing discharges will be considered consistent with the TMDL provided that the NPDES permit requires in-stream criteria to be met.

Table 5-2 Wasteload Allocations for NPDES-Permitted Facilities

Waterbody ID	NPDES Permit No.	Name	Design Flow (mgd)	Disin-fection	Wasteload Allocation (cfu/day)		
					Fecal Coliform	*E. Coli*	Enterococci
OK6209100500100_00 Kingfisher Creek	OK0022811	Kingfisher Public Works Auth.	0.8	Yes	6.06E+09	3.82E+09	9.99E+08
OK620910040120_00 Deer Creek	OK0027561	OK city Wtr Utils Trust-Deer Creek	15	Yes	1.14E+11	NA	NA
OK620910030110 Horse Creek to Skeleton Creek	OKG5800004	Marshall, Town of	0.053	No	4.01E+08	2.53E+08	6.62E+07
OK620910020310_00 Indian Creek	OKG580047	Ringwood, Town of	0.052	No	NA	2.48E+08	6.50E+07

Permitted stormwater discharges are considered point sources. The WLA calculations for MS4s must be expressed as different maximum loads allowable under different flow conditions. Therefore the percentage of a watershed under a MS4 jurisdictional is used to estimate the MS4 contribution. The only urbanized area designated as an MS4 within this Study Area is the City of Oklahoma City located in the Deer Creek (OK620910040120_00) watershed. The flow dependent calculations for the WLA established for the City of Oklahoma City, ODOT and OTA MS4 are provided in Table 5-3.

5.3 Load Allocation

As discussed in Section 3, nonpoint source bacteria loading to the receiving streams of each waterbody emanate from a number of different sources. The data analysis and the LDCs demonstrate that exceedances at the WQM stations are the result of a variety of nonpoint source loading. The LAs for each stream segment are calculated as the difference between the TMDL, MOS, and WLA for WWTP and MS4s as follows:

LA = TMDL – WLA_WWTP – WLA_MS4 - MOS

5.4 Seasonal Variability

Federal regulations (40 CFR §130.7(c)(1)) require that TMDLs account for seasonal variation in watershed conditions and pollutant loading. The TMDLs established in this report adhere to the seasonal application of the Oklahoma WQS, which limits the PBCR use to the period of May 1st through September 30th. Seasonal variation was also accounted for in these TMDLs by using more than 5 years of water quality data and by using the longest period of USGS flow records when estimating flows to develop flow exceedance percentiles.

5.5 Margin of Safety

Federal regulations (40 CFR §130.7(c)(1)) require that TMDLs include an MOS. The MOS is a conservative measure incorporated into the TMDL equation that accounts for the lack of knowledge associated with calculating the allowable pollutant loading to ensure WQSs are attained. USEPA guidance allows for use of implicit or explicit expressions of the MOS, or both. When conservative assumptions are used in development of the TMDL, or conservative factors are used in the calculations, the MOS is implicit. When a specific percentage of the TMDL is set aside to account for lack of knowledge, then the MOS is considered explicit.

For the explicit MOS the water quality target was set at 10 percent lower than the water quality criterion for each pathogen which equates to 360 cfu/100 mL, 365.4 cfu/100 mL, and 97.2/100 mL for fecal coliform, *E. coli*, and Enterococci, respectively. The net effect of the TMDL with MOS is that the allowable pollutant loading of each waterbody is slightly reduced. The use of in-stream bacteria concentrations to estimate existing loading is another conservative element utilized in these TMDLs that can be recognized as an implicit MOS. This conservative approach to establishing the MOS will ensure that both the 30-day geometric mean and instantaneous bacteria standards can be achieved and maintained.

5.6 TMDL Calculations

The bacteria TMDLs for the 303(d)-listed stream segments covered in this report were derived using LDCs. A TMDL is expressed as the sum of all WLAs (point source loads), LAs (nonpoint source loads), and an appropriate MOS, which attempts to account for lack of knowledge concerning the relationship between effluent limitations and water quality.

This definition can be expressed by the following equation:

$$TMDL = \Sigma\ WLA + \Sigma\ LA + MOS$$

Where the Σ WLA component can be further divided into WLA for WWTPs and WLA for MS4s:

$$\Sigma\ WLA = WLA\_WWTP + WLA\_MS4$$

For each stream segment the TMDLs presented in this report are expressed as a percent reduction across the full range of flow conditions. The TMDL, WLA, LA, and MOS will vary with flow condition, and are calculated at every 5^{th} flow interval percentile (Tables 5-4 through 5-18). For illustrative purposes, the TMDL, WLA, LA, and MOS are calculated at the median flow (50% exceedance) for the bacteria indicator which requires the most stringent PRG in each stream segment in Table 5-3. The WLA component of each TMDL is the sum of all WLAs within the contributing watershed of each stream segment. The sum of the WLAs can be represented as a single line below the LDC. The LDC and the simple equation of:

$$Average\ LA = average\ TMDL - MOS - WLA\_WWTP - WLA\_MS4$$

can provide an individual value for the LA in counts per day, which represents the area under the TMDL target line and above the WLA line. For MS4s the load reduction will be the same as the PRG established for the overall watershed. When there are no continuous point sources the WLA_WWTP is zero. The LDCs and TMDL calculations for additional bacterial indicators are provided in Subsection 5.7.

Table 5-3 TMDL Summary Examples

WQM Station	Waterbody ID	Waterbody Name	Indicator Bacteria Species	TMDL† (cfu/day)	WLA_WWTP† (cfu/day)	WLA_MS4 (cfu/day)	LA† (cfu/day)	MOS† (cfu/day)
OK620910010010-001AT	OK620910010010_00	Cimarron River	ENT	1.06E+12	0.00E+00	0.00E+00	9.51E+11	1.06E+11
OK620910-02-0040C	OK620910020040_00	Cooper Creek	ENT	1.26E+10	0.00E+00	0.00E+00	1.14E+10	1.26E+09
OK620910-02-0250C	OK620910020250_00	Deep Creek	ENT	9.27E+09	0.00E+00	0.00E+00	8.34E+09	9.27E+08
OK620910-02-0270G	OK620910020270_00	Elm Creek	FC	1.02E+10	0.00E+00	0.00E+00	9.14E+09	1.02E+09
OK620910-02-0310C	OK620910020310_00	Indian Creek	ENT	7.99E+09	6.50E+07	0.00E+00	7.13E+09	7.99E+08
OK620910030010-001AT OK620910-03-0010F OK620910-03-0010S	OK620910030010_00	Skeleton Creek	ENT	4.76E+10	6.62E+07	0.00E+00	4.27E+10	4.76E+09
OK620910-04-0010G	OK620910040010_20	Cottonwood Creek	FC	1.71E+11	0.00E+00	0.00E+00	1.54E+11	1.71E+10
OK620910-04-0120B	OK620910040120_00	Deer Creek	FC	4.33E+11	1.14E+11	1.58E+10	2.61E+11	4.33E+10
OK620910-05-0010G OK620910-05-0010J	OK620910050010_00	Kingfisher Creek	ENT	6.95E+09	9.99E+08	0.00E+00	5.26E+09	6.95E+08
OK620910-05-0020G	OK620910050020_00	Trail Creek	FC	1.58E+09	0.00E+00	0.00E+00	1.42E+09	1.58E+08
OK620910-05-0030C	OK620910050030_00	Uncle Johns Creek	ENT	3.63E+09	0.00E+00	0.00E+00	3.27E+09	3.63E+08
OK620910-05-0080D	OK620910050080_00	Dead Indian Creek	ENT	2.71E+09	0.00E+00	0.00E+00	2.44E+09	2.71E+08

† Derived for illustrative purposes at the median flow value

Table 5-4 Enterococci TMDL Calculations for Cimarron River (OK620910010010_00)

Percentile	Flow (cfs)	TMDL† (cfu/day)	WLA_WWTP† (cfu/day)	WLA_MS4 (cfu/day)	LA† (cfu/day)	MOS† (cfu/day)
0	112,000.0	2.96E+14	0.00E+00	0.00E+00	2.66E+14	2.96E+13
5	5,994.5	1.58E+13	0.00E+00	0.00E+00	1.43E+13	1.58E+12
10	3,100.0	8.19E+12	0.00E+00	0.00E+00	7.37E+12	8.19E+11
15	2,040.0	5.39E+12	0.00E+00	0.00E+00	4.85E+12	5.39E+11
20	1,440.0	3.80E+12	0.00E+00	0.00E+00	3.42E+12	3.80E+11
25	1,090.0	2.88E+12	0.00E+00	0.00E+00	2.59E+12	2.88E+11
30	877.0	2.32E+12	0.00E+00	0.00E+00	2.09E+12	2.32E+11
35	704.2	1.86E+12	0.00E+00	0.00E+00	1.67E+12	1.86E+11
40	586.0	1.55E+12	0.00E+00	0.00E+00	1.39E+12	1.55E+11
45	480.0	1.27E+12	0.00E+00	0.00E+00	1.14E+12	1.27E+11
50	400.0	1.06E+12	0.00E+00	0.00E+00	9.51E+11	1.06E+11
55	328.0	8.67E+11	0.00E+00	0.00E+00	7.80E+11	8.67E+10
60	273.0	7.21E+11	0.00E+00	0.00E+00	6.49E+11	7.21E+10
65	224.0	5.92E+11	0.00E+00	0.00E+00	5.33E+11	5.92E+10
70	184.0	4.86E+11	0.00E+00	0.00E+00	4.38E+11	4.86E+10
75	145.0	3.83E+11	0.00E+00	0.00E+00	3.45E+11	3.83E+10
80	112.00	2.96E+11	0.00E+00	0.00E+00	2.66E+11	2.96E+10
85	87.00	2.30E+11	0.00E+00	0.00E+00	2.07E+11	2.30E+10
90	57.00	1.51E+11	0.00E+00	0.00E+00	1.36E+11	1.51E+10
95	26.00	6.87E+10	0.00E+00	0.00E+00	6.18E+10	6.87E+09
100	0.50	1.32E+09	0.00E+00	0.00E+00	1.19E+09	1.32E+08

Table 5-5 Enterococci TMDL Calculations for Cooper Creek (OK620910020040_00)

Percentile	Flow (cfs)	TMDL† (cfu/day)	WLA_WWTP† (cfu/day)	WLA_MS4 (cfu/day)	LA† (cfu/day)	MOS† (cfu/day)
0	3,347.5	8.84E+12	0.00E+00	0.00E+00	7.96E+12	8.84E+11
5	102.1	2.70E+11	0.00E+00	0.00E+00	2.43E+11	2.70E+10
10	29.0	7.66E+10	0.00E+00	0.00E+00	6.90E+10	7.66E+09
15	17.5	4.63E+10	0.00E+00	0.00E+00	4.17E+10	4.63E+09
20	12.1	3.19E+10	0.00E+00	0.00E+00	2.87E+10	3.19E+09
25	9.7	2.55E+10	0.00E+00	0.00E+00	2.30E+10	2.55E+09
30	7.9	2.08E+10	0.00E+00	0.00E+00	1.87E+10	2.08E+09
35	6.6	1.76E+10	0.00E+00	0.00E+00	1.58E+10	1.76E+09
40	6.0	1.60E+10	0.00E+00	0.00E+00	1.44E+10	1.60E+09
45	5.4	1.44E+10	0.00E+00	0.00E+00	1.29E+10	1.44E+09
50	4.8	1.26E+10	0.00E+00	0.00E+00	1.14E+10	1.26E+09
55	4.2	1.12E+10	0.00E+00	0.00E+00	1.01E+10	1.12E+09
60	3.6	9.42E+09	0.00E+00	0.00E+00	8.48E+09	9.42E+08
65	3.2	8.46E+09	0.00E+00	0.00E+00	7.61E+09	8.46E+08
70	2.8	7.41E+09	0.00E+00	0.00E+00	6.67E+09	7.41E+08
75	2.5	6.55E+09	0.00E+00	0.00E+00	5.89E+09	6.55E+08
80	2.03	5.36E+09	0.00E+00	0.00E+00	4.83E+09	5.36E+08
85	1.69	4.47E+09	0.00E+00	0.00E+00	4.02E+09	4.47E+08
90	1.33	3.51E+09	0.00E+00	0.00E+00	3.16E+09	3.51E+08
95	0.73	1.92E+09	0.00E+00	0.00E+00	1.72E+09	1.92E+08
100	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 5-6 Enterococci TMDL Calculations for Deep Creek (OK620910020250_00)

Percentile	Flow (cfs)	TMDL† (cfu/day)	WLA_WWTP† (cfu/day)	WLA_MS4 (cfu/day)	LA† (cfu/day)	MOS† (cfu/day)
0	2,430.0	6.42E+12	0.00E+00	0.00E+00	5.78E+12	6.42E+11
5	74.1	1.96E+11	0.00E+00	0.00E+00	1.76E+11	1.96E+10
10	21.1	5.56E+10	0.00E+00	0.00E+00	5.01E+10	5.56E+09
15	12.7	3.36E+10	0.00E+00	0.00E+00	3.02E+10	3.36E+09
20	8.8	2.32E+10	0.00E+00	0.00E+00	2.09E+10	2.32E+09
25	7.0	1.85E+10	0.00E+00	0.00E+00	1.67E+10	1.85E+09
30	5.7	1.51E+10	0.00E+00	0.00E+00	1.36E+10	1.51E+09
35	4.8	1.27E+10	0.00E+00	0.00E+00	1.15E+10	1.27E+09
40	4.4	1.16E+10	0.00E+00	0.00E+00	1.04E+10	1.16E+09
45	3.9	1.04E+10	0.00E+00	0.00E+00	9.39E+09	1.04E+09
50	3.5	9.27E+09	0.00E+00	0.00E+00	8.34E+09	9.27E+08
55	3.1	8.11E+09	0.00E+00	0.00E+00	7.30E+09	8.11E+08
60	2.6	6.84E+09	0.00E+00	0.00E+00	6.15E+09	6.84E+08
65	2.3	6.14E+09	0.00E+00	0.00E+00	5.53E+09	6.14E+08
70	2.1	5.42E+09	0.00E+00	0.00E+00	4.88E+09	5.42E+08
75	1.8	4.75E+09	0.00E+00	0.00E+00	4.28E+09	4.75E+08
80	1.49	3.94E+09	0.00E+00	0.00E+00	3.55E+09	3.94E+08
85	1.23	3.24E+09	0.00E+00	0.00E+00	2.92E+09	3.24E+08
90	0.96	2.55E+09	0.00E+00	0.00E+00	2.29E+09	2.55E+08
95	0.53	1.39E+09	0.00E+00	0.00E+00	1.25E+09	1.39E+08
100	0.04	1.04E+08	0.00E+00	0.00E+00	9.39E+07	1.04E+07

Table 5-7 Fecal Coliform TMDL Calculations for Elm Creek (OK620910020270_00)

Percentile	Flow (cfs)	TMDL† (cfu/day)	WLA_WWTP† (cfu/day)	WLA_MS4 (cfu/day)	LA† (cfu/day)	MOS† (cfu/day)
0	723.6	7.08E+12	0.00E+00	0.00E+00	6.37E+12	7.08E+11
5	22.1	2.16E+11	0.00E+00	0.00E+00	1.94E+11	2.16E+10
10	6.4	6.26E+10	0.00E+00	0.00E+00	5.64E+10	6.26E+09
15	3.8	3.71E+10	0.00E+00	0.00E+00	3.34E+10	3.71E+09
20	2.6	2.56E+10	0.00E+00	0.00E+00	2.30E+10	2.56E+09
25	2.1	2.04E+10	0.00E+00	0.00E+00	1.84E+10	2.04E+09
30	1.7	1.66E+10	0.00E+00	0.00E+00	1.50E+10	1.66E+09
35	1.4	1.41E+10	0.00E+00	0.00E+00	1.27E+10	1.41E+09
40	1.3	1.28E+10	0.00E+00	0.00E+00	1.15E+10	1.28E+09
45	1.2	1.15E+10	0.00E+00	0.00E+00	1.04E+10	1.15E+09
50	1.0	1.02E+10	0.00E+00	0.00E+00	9.14E+09	1.02E+09
55	0.9	8.95E+09	0.00E+00	0.00E+00	8.05E+09	8.95E+08
60	0.8	7.54E+09	0.00E+00	0.00E+00	6.79E+09	7.54E+08
65	0.7	6.77E+09	0.00E+00	0.00E+00	6.10E+09	6.77E+08
70	0.6	5.88E+09	0.00E+00	0.00E+00	5.29E+09	5.88E+08
75	0.5	5.24E+09	0.00E+00	0.00E+00	4.72E+09	5.24E+08
80	0.44	4.35E+09	0.00E+00	0.00E+00	3.91E+09	4.35E+08
85	0.37	3.58E+09	0.00E+00	0.00E+00	3.22E+09	3.58E+08
90	0.29	2.81E+09	0.00E+00	0.00E+00	2.53E+09	2.81E+08
95	0.16	1.53E+09	0.00E+00	0.00E+00	1.38E+09	1.53E+08
100	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 5-8 Enterococci TMDL Calculations for Indian Creek (OK620910020310_00)

Percentile	Flow (cfs)	TMDL† (cfu/day)	WLA_WWTP† (cfu/day)	WLA_MS4 (cfu/day)	LA† (cfu/day)	MOS† (cfu/day)
0	2,094.2	5.53E+12	6.50E+07	0.00E+00	4.98E+12	5.53E+11
5	63.9	1.69E+11	6.50E+07	0.00E+00	1.52E+11	1.69E+10
10	18.1	4.79E+10	6.50E+07	0.00E+00	4.31E+10	4.79E+09
15	11.0	2.90E+10	6.50E+07	0.00E+00	2.60E+10	2.90E+09
20	7.6	2.00E+10	6.50E+07	0.00E+00	1.79E+10	2.00E+09
25	6.0	1.60E+10	6.50E+07	0.00E+00	1.43E+10	1.60E+09
30	4.9	1.30E+10	6.50E+07	0.00E+00	1.16E+10	1.30E+09
35	4.2	1.10E+10	6.50E+07	0.00E+00	9.82E+09	1.10E+09
40	3.8	9.99E+09	6.50E+07	0.00E+00	8.92E+09	9.99E+08
45	3.5	9.19E+09	6.50E+07	0.00E+00	8.20E+09	9.19E+08
50	3.0	7.99E+09	6.50E+07	0.00E+00	7.13E+09	7.99E+08
55	2.6	6.99E+09	6.50E+07	0.00E+00	6.23E+09	6.99E+08
60	2.3	5.99E+09	6.50E+07	0.00E+00	5.33E+09	5.99E+08
65	2.0	5.29E+09	6.50E+07	0.00E+00	4.70E+09	5.29E+08
70	1.8	4.69E+09	6.50E+07	0.00E+00	4.16E+09	4.69E+08
75	1.6	4.17E+09	6.50E+07	0.00E+00	3.69E+09	4.17E+08
80	1.29	3.40E+09	6.50E+07	0.00E+00	2.99E+09	3.40E+08
85	1.06	2.80E+09	6.50E+07	0.00E+00	2.45E+09	2.80E+08
90	0.83	2.20E+09	6.50E+07	0.00E+00	1.91E+09	2.20E+08
95	0.45	1.20E+09	6.50E+07	0.00E+00	1.01E+09	1.20E+08
100	0.03	8.99E+07	6.50E+07	0.00E+00	1.59E+07	8.99E+06

Table 5-9 Enterococci TMDL Calculations for Skeleton Creek (OK620910030010_00)

Percentile	Flow (cfs)	TMDL† (cfu/day)	WLA_WWTP† (cfu/day)	WLA_MS4 (cfu/day)	LA† (cfu/day)	MOS† (cfu/day)
0	39,200.0	1.04E+14	6.62E+07	0.00E+00	9.32E+13	1.04E+13
5	758.0	2.00E+12	6.62E+07	0.00E+00	1.80E+12	2.00E+11
10	267.0	7.05E+11	6.62E+07	0.00E+00	6.35E+11	7.05E+10
15	142.0	3.75E+11	6.62E+07	0.00E+00	3.38E+11	3.75E+10
20	90.0	2.38E+11	6.62E+07	0.00E+00	2.14E+11	2.38E+10
25	62.8	1.66E+11	6.62E+07	0.00E+00	1.49E+11	1.66E+10
30	45.0	1.19E+11	6.62E+07	0.00E+00	1.07E+11	1.19E+10
35	35.0	9.25E+10	6.62E+07	0.00E+00	8.32E+10	9.25E+09
40	28.0	7.40E+10	6.62E+07	0.00E+00	6.65E+10	7.40E+09
45	22.0	5.81E+10	6.62E+07	0.00E+00	5.22E+10	5.81E+09
50	18.0	4.76E+10	6.62E+07	0.00E+00	4.27E+10	4.76E+09
55	15.0	3.96E+10	6.62E+07	0.00E+00	3.56E+10	3.96E+09
60	12.0	3.17E+10	6.62E+07	0.00E+00	2.85E+10	3.17E+09
65	10.0	2.64E+10	6.62E+07	0.00E+00	2.37E+10	2.64E+09
70	8.6	2.27E+10	6.62E+07	0.00E+00	2.04E+10	2.27E+09
75	7.0	1.85E+10	6.62E+07	0.00E+00	1.66E+10	1.85E+09
80	5.90	1.56E+10	6.62E+07	0.00E+00	1.40E+10	1.56E+09
85	4.70	1.24E+10	6.62E+07	0.00E+00	1.11E+10	1.24E+09
90	3.60	9.51E+09	6.62E+07	0.00E+00	8.49E+09	9.51E+08
95	2.10	5.55E+09	6.62E+07	0.00E+00	4.93E+09	5.55E+08
100	0.00	0.00E+00	6.62E+07	0.00E+00	-6.62E+07	0.00E+00

Table 5-10 Fecal Coliform TMDL Calculations for Cottonwood Creek (OK620910040010_20)

Percentile	Flow (cfs)	TMDL† (cfu/day)	WLA_WWTP† (cfu/day)	WLA_MS4 (cfu/day)	LA† (cfu/day)	MOS† (cfu/day)
0	7,570.1	7.41E+13	0.00E+00	0.00E+00	6.67E+13	7.41E+12
5	268.4	2.63E+12	0.00E+00	0.00E+00	2.36E+12	2.63E+11
10	140.1	1.37E+12	0.00E+00	0.00E+00	1.23E+12	1.37E+11
15	77.8	7.62E+11	0.00E+00	0.00E+00	6.86E+11	7.62E+10
20	51.1	5.00E+11	0.00E+00	0.00E+00	4.50E+11	5.00E+10
25	37.9	3.71E+11	0.00E+00	0.00E+00	3.34E+11	3.71E+10
30	30.4	2.98E+11	0.00E+00	0.00E+00	2.68E+11	2.98E+10
35	25.1	2.46E+11	0.00E+00	0.00E+00	2.21E+11	2.46E+10
40	20.9	2.05E+11	0.00E+00	0.00E+00	1.84E+11	2.05E+10
45	19.0	1.86E+11	0.00E+00	0.00E+00	1.68E+11	1.86E+10
50	17.5	1.71E+11	0.00E+00	0.00E+00	1.54E+11	1.71E+10
55	16.0	1.56E+11	0.00E+00	0.00E+00	1.41E+11	1.56E+10
60	14.1	1.38E+11	0.00E+00	0.00E+00	1.24E+11	1.38E+10
65	12.2	1.19E+11	0.00E+00	0.00E+00	1.07E+11	1.19E+10
70	11.0	1.08E+11	0.00E+00	0.00E+00	9.72E+10	1.08E+10
75	9.5	9.31E+10	0.00E+00	0.00E+00	8.38E+10	9.31E+09
80	7.99	7.82E+10	0.00E+00	0.00E+00	7.04E+10	7.82E+09
85	7.23	7.07E+10	0.00E+00	0.00E+00	6.37E+10	7.07E+09
90	6.47	6.33E+10	0.00E+00	0.00E+00	5.70E+10	6.33E+09
95	5.33	5.21E+10	0.00E+00	0.00E+00	4.69E+10	5.21E+09
100	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 5-11 Fecal Coliform TMDL Calculations for Deer Creek (OK620910040120_20)

Percentile	Flow (cfs)	TMDL† (cfu/day)	WLA_WWTP† (cfu/day)	WLA_MS4 (cfu/day)	LA† (cfu/day)	MOS† (cfu/day)
0	9,146.6	8.95E+13	1.14E+11	4.58E+12	7.59E+13	8.95E+12
5	348.3	3.41E+12	1.14E+11	1.68E+11	2.79E+12	3.41E+11
10	192.7	1.89E+12	1.14E+11	9.02E+10	1.49E+12	1.89E+11
15	117.5	1.15E+12	1.14E+11	5.25E+10	8.69E+11	1.15E+11
20	85.1	8.33E+11	1.14E+11	3.62E+10	6.00E+11	8.33E+10
25	69.5	6.80E+11	1.14E+11	2.84E+10	4.70E+11	6.80E+10
30	59.9	5.86E+11	1.14E+11	2.36E+10	3.90E+11	5.86E+10
35	53.5	5.23E+11	1.14E+11	2.04E+10	3.37E+11	5.23E+10
40	48.9	4.78E+11	1.14E+11	1.81E+10	2.99E+11	4.78E+10
45	46.2	4.52E+11	1.14E+11	1.67E+10	2.76E+11	4.52E+10
50	44.3	4.33E+11	1.14E+11	1.58E+10	2.61E+11	4.33E+10
55	42.5	4.16E+11	1.14E+11	1.48E+10	2.46E+11	4.16E+10
60	40.2	3.93E+11	1.14E+11	1.37E+10	2.27E+11	3.93E+10
65	37.9	3.71E+11	1.14E+11	1.25E+10	2.07E+11	3.71E+10
70	36.5	3.57E+11	1.14E+11	1.19E+10	1.96E+11	3.57E+10
75	34.7	3.39E+11	1.14E+11	1.09E+10	1.81E+11	3.39E+10
80	32.84	3.21E+11	1.14E+11	1.00E+10	1.66E+11	3.21E+10
85	31.92	3.12E+11	1.14E+11	9.55E+09	1.58E+11	3.12E+10
90	31.00	3.03E+11	1.14E+11	9.09E+09	1.50E+11	3.03E+10
95	30.09	2.94E+11	1.14E+11	8.63E+09	1.43E+11	2.94E+10
100	27.11	2.65E+11	1.14E+11	7.13E+09	1.18E+11	2.65E+10

Table 5-12 Enterococci TMDL Calculations for Kingfisher Creek (OK620910050010_00)

Percentile	Flow (cfs)	TMDL† (cfu/day)	WLA_WWTP† (cfu/day)	WLA_MS4 (cfu/day)	LA† (cfu/day)	MOS† (cfu/day)
0	6,481.2	1.71E+13	9.99E+08	0.00E+00	1.54E+13	1.71E+12
5	134.7	3.56E+11	9.99E+08	0.00E+00	3.19E+11	3.56E+10
10	46.3	1.22E+11	9.99E+08	0.00E+00	1.09E+11	1.22E+10
15	19.9	5.25E+10	9.99E+08	0.00E+00	4.63E+10	5.25E+09
20	11.2	2.95E+10	9.99E+08	0.00E+00	2.55E+10	2.95E+09
25	7.3	1.94E+10	9.99E+08	0.00E+00	1.64E+10	1.94E+09
30	5.5	1.46E+10	9.99E+08	0.00E+00	1.22E+10	1.46E+09
35	4.4	1.17E+10	9.99E+08	0.00E+00	9.55E+09	1.17E+09
40	3.5	9.35E+09	9.99E+08	0.00E+00	7.41E+09	9.35E+08
45	3.0	8.03E+09	9.99E+08	0.00E+00	6.22E+09	8.03E+08
50	2.6	6.95E+09	9.99E+08	0.00E+00	5.26E+09	6.95E+08
55	2.1	5.62E+09	9.99E+08	0.00E+00	4.06E+09	5.62E+08
60	1.9	4.95E+09	9.99E+08	0.00E+00	3.46E+09	4.95E+08
65	1.7	4.44E+09	9.99E+08	0.00E+00	3.00E+09	4.44E+08
70	1.6	4.11E+09	9.99E+08	0.00E+00	2.70E+09	4.11E+08
75	1.4	3.77E+09	9.99E+08	0.00E+00	2.40E+09	3.77E+08
80	1.36	3.60E+09	9.99E+08	0.00E+00	2.24E+09	3.60E+08
85	1.30	3.44E+09	9.99E+08	0.00E+00	2.09E+09	3.44E+08
90	1.27	3.35E+09	9.99E+08	0.00E+00	2.02E+09	3.35E+08
95	1.24	3.27E+09	9.99E+08	0.00E+00	1.94E+09	3.27E+08
100	1.24	3.27E+09	9.99E+08	0.00E+00	1.94E+09	3.27E+08

Table 5-13 Fecal Coliform TMDL Calculations for Trail Creek (OK620910050020_00)

Percentile	Flow (cfs)	TMDL† (cfu/day)	WLA_WWTP† (cfu/day)	WLA_MS4 (cfu/day)	LA† (cfu/day)	MOS† (cfu/day)
0	751.2	7.35E+12	0.00E+00	0.00E+00	6.62E+12	7.35E+11
5	15.6	1.53E+11	0.00E+00	0.00E+00	1.38E+11	1.53E+10
10	5.2	5.10E+10	0.00E+00	0.00E+00	4.59E+10	5.10E+09
15	2.1	2.04E+10	0.00E+00	0.00E+00	1.84E+10	2.04E+09
20	1.2	1.13E+10	0.00E+00	0.00E+00	1.02E+10	1.13E+09
25	0.7	7.18E+09	0.00E+00	0.00E+00	6.46E+09	7.18E+08
30	0.5	5.03E+09	0.00E+00	0.00E+00	4.52E+09	5.03E+08
35	0.4	3.81E+09	0.00E+00	0.00E+00	3.43E+09	3.81E+08
40	0.3	2.72E+09	0.00E+00	0.00E+00	2.45E+09	2.72E+08
45	0.21	2.08E+09	0.00E+00	0.00E+00	1.87E+09	2.08E+08
50	0.16	1.58E+09	0.00E+00	0.00E+00	1.42E+09	1.58E+08
55	0.11	1.03E+09	0.00E+00	0.00E+00	9.29E+08	1.03E+08
60	0.08	7.49E+08	0.00E+00	0.00E+00	6.74E+08	7.49E+07
65	0.05	5.03E+08	0.00E+00	0.00E+00	4.52E+08	5.03E+07
70	0.04	3.59E+08	0.00E+00	0.00E+00	3.23E+08	3.59E+07
75	0.02	2.15E+08	0.00E+00	0.00E+00	1.94E+08	2.15E+07
80	0.015	1.44E+08	0.00E+00	0.00E+00	1.29E+08	1.44E+07
85	0.007	7.18E+07	0.00E+00	0.00E+00	6.46E+07	7.18E+06
90	0.003	3.40E+07	0.00E+00	0.00E+00	3.06E+07	3.40E+06
95	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Table 5-14 Enterococci TMDL Calculations for Uncle Johns Creek (OK620910050030_00)

Percentile	Flow (cfs)	TMDL† (cfu/day)	WLA_WWTP† (cfu/day)	WLA_MS4 (cfu/day)	LA† (cfu/day)	MOS† (cfu/day)
0	6,398	1.69E+13	0.00E+00	0.00E+00	1.52E+13	1.69E+12
5	130	3.44E+11	0.00E+00	0.00E+00	3.09E+11	3.44E+10
10	44	1.17E+11	0.00E+00	0.00E+00	1.06E+11	1.17E+10
15	18	4.70E+10	0.00E+00	0.00E+00	4.23E+10	4.70E+09
20	10	2.53E+10	0.00E+00	0.00E+00	2.28E+10	2.53E+09
25	6	1.59E+10	0.00E+00	0.00E+00	1.43E+10	1.59E+09
30	4	1.12E+10	0.00E+00	0.00E+00	1.01E+10	1.12E+09
35	3	8.35E+09	0.00E+00	0.00E+00	7.51E+09	8.35E+08
40	2.3	6.00E+09	0.00E+00	0.00E+00	5.40E+09	6.00E+08
45	1.8	4.70E+09	0.00E+00	0.00E+00	4.23E+09	4.70E+08
50	1.4	3.63E+09	0.00E+00	0.00E+00	3.27E+09	3.63E+08
55	0.9	2.32E+09	0.00E+00	0.00E+00	2.09E+09	2.32E+08
60	0.6	1.67E+09	0.00E+00	0.00E+00	1.50E+09	1.67E+08
65	0.44	1.16E+09	0.00E+00	0.00E+00	1.04E+09	1.16E+08
70	0.31	8.26E+08	0.00E+00	0.00E+00	7.43E+08	8.26E+07
75	0.19	4.95E+08	0.00E+00	0.00E+00	4.46E+08	4.95E+07
80	0.13	3.30E+08	0.00E+00	0.00E+00	2.97E+08	3.30E+07
85	0.06	1.65E+08	0.00E+00	0.00E+00	1.49E+08	1.65E+07
90	0.03	7.83E+07	0.00E+00	0.00E+00	7.04E+07	7.83E+06
95	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

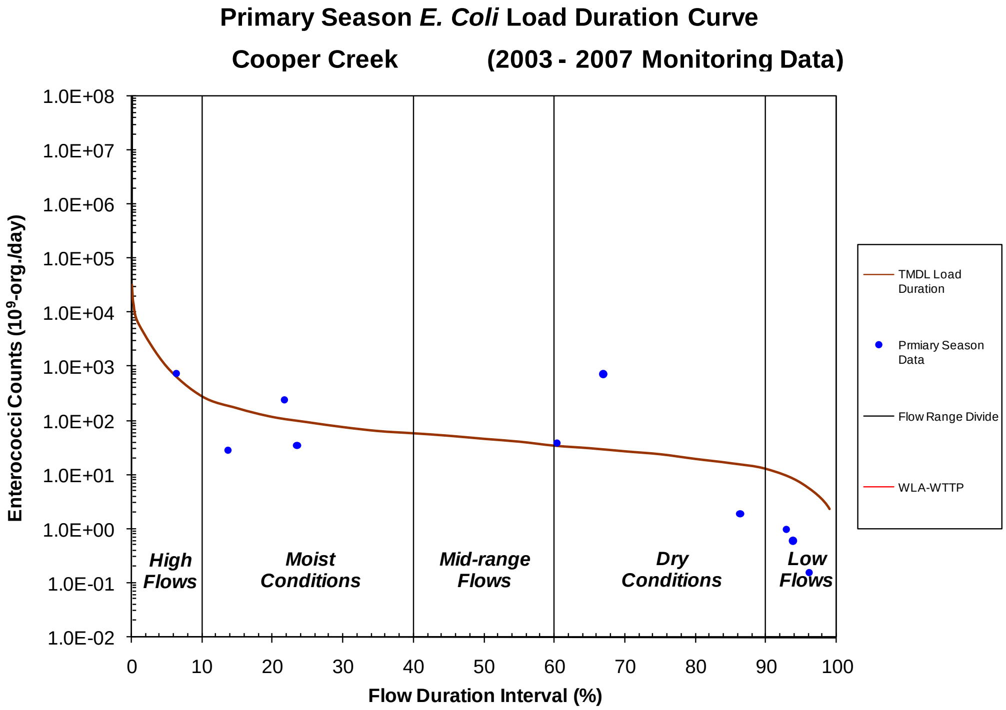
Table 5-15 Enterococci TMDL Calculations for Dead Indian Creek (OK121600050080_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	4,766	1.26E+13	0.00E+00	0.00E+00	1.13E+13	1.26E+12
5	97	2.56E+11	0.00E+00	0.00E+00	2.30E+11	2.56E+10
10	33	8.74E+10	0.00E+00	0.00E+00	7.87E+10	8.74E+09
15	13	3.50E+10	0.00E+00	0.00E+00	3.15E+10	3.50E+09
20	7	1.88E+10	0.00E+00	0.00E+00	1.70E+10	1.88E+09
25	4	1.19E+10	0.00E+00	0.00E+00	1.07E+10	1.19E+09
30	3	8.37E+09	0.00E+00	0.00E+00	7.53E+09	8.37E+08
35	2.3	6.15E+09	0.00E+00	0.00E+00	5.54E+09	6.15E+08
40	1.7	4.47E+09	0.00E+00	0.00E+00	4.02E+09	4.47E+08
45	1.3	3.50E+09	0.00E+00	0.00E+00	3.15E+09	3.50E+08
50	1.0	2.71E+09	0.00E+00	0.00E+00	2.44E+09	2.71E+08
55	0.7	1.73E+09	0.00E+00	0.00E+00	1.56E+09	1.73E+08
60	0.47	1.23E+09	0.00E+00	0.00E+00	1.11E+09	1.23E+08
65	0.33	8.61E+08	0.00E+00	0.00E+00	7.75E+08	8.61E+07
70	0.23	6.15E+08	0.00E+00	0.00E+00	5.54E+08	6.15E+07
75	0.14	3.69E+08	0.00E+00	0.00E+00	3.32E+08	3.69E+07
80	0.09	2.46E+08	0.00E+00	0.00E+00	2.21E+08	2.46E+07
85	0.05	1.23E+08	0.00E+00	0.00E+00	1.11E+08	1.23E+07
90	0.02	5.83E+07	0.00E+00	0.00E+00	5.25E+07	5.83E+06
95	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

5.7 LDCs and TMDL Calculations for Additional Bacterial Indicators

As mentioned previously in Section 5.1, USEPA regulations at 40 CFR 130.7(c) (1) require TMDLs to take into account critical conditions for stream flow, loading, and all applicable water quality standards. To accomplish this, available instream WQM data were evaluated with respect to flows and magnitude of water quality criteria exceedance using LDCs. Furthermore as required, TMDL calculations from LDCs for all bacterial indicators not supporting the PBCR use were prepared. The remaining LDCs and TMDL calculations for additional bacterial indicators are shown in Figures 5-13 through 5-21 and Tables 5-16 through 5-24 respectively.

Figure 5-13



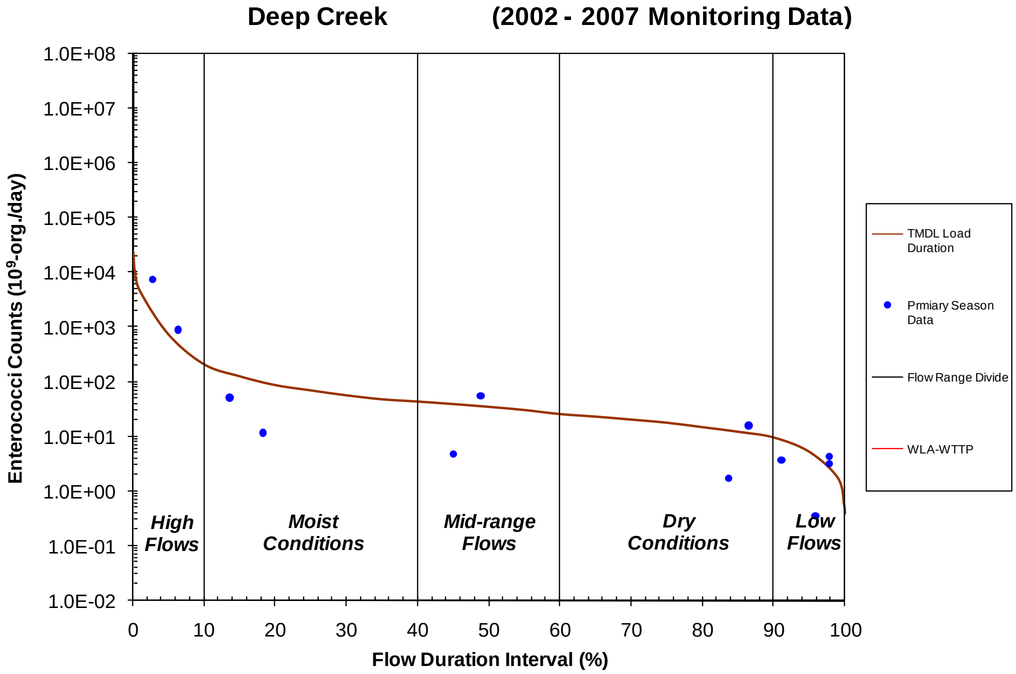
* there is no wasteload allocation for this waterbody

Table 5-16 *E. Coli* TMDL Calculations for Cooper Creek (OK620910020040_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	3,347.5	3.32E+13	0.00E+00	0.00E+00	2.99E+13	3.32E+12
5	102.1	1.01E+12	0.00E+00	0.00E+00	9.13E+11	1.01E+11
10	29.0	2.88E+11	0.00E+00	0.00E+00	2.59E+11	2.88E+10
15	17.5	1.74E+11	0.00E+00	0.00E+00	1.57E+11	1.74E+10
20	12.1	1.20E+11	0.00E+00	0.00E+00	1.08E+11	1.20E+10
25	9.7	9.60E+10	0.00E+00	0.00E+00	8.64E+10	9.60E+09
30	7.9	7.80E+10	0.00E+00	0.00E+00	7.02E+10	7.80E+09
35	6.6	6.60E+10	0.00E+00	0.00E+00	5.94E+10	6.60E+09
40	6.0	6.00E+10	0.00E+00	0.00E+00	5.40E+10	6.00E+09
45	5.4	5.40E+10	0.00E+00	0.00E+00	4.86E+10	5.40E+09
50	4.8	4.74E+10	0.00E+00	0.00E+00	4.27E+10	4.74E+09
55	4.2	4.20E+10	0.00E+00	0.00E+00	3.78E+10	4.20E+09
60	3.6	3.54E+10	0.00E+00	0.00E+00	3.19E+10	3.54E+09
65	3.2	3.18E+10	0.00E+00	0.00E+00	2.86E+10	3.18E+09
70	2.8	2.78E+10	0.00E+00	0.00E+00	2.51E+10	2.78E+09
75	2.5	2.46E+10	0.00E+00	0.00E+00	2.21E+10	2.46E+09
80	2.03	2.02E+10	0.00E+00	0.00E+00	1.81E+10	2.02E+09
85	1.69	1.68E+10	0.00E+00	0.00E+00	1.51E+10	1.68E+09
90	1.33	1.32E+10	0.00E+00	0.00E+00	1.19E+10	1.32E+09
95	0.73	7.20E+09	0.00E+00	0.00E+00	6.48E+09	7.20E+08
100	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Figure 5-14

Primary Season *E. Coli* Load Duration Curve



* there is no wasteload allocation for this waterbody

Table 5-17 *E. Coli* TMDL Calculations for Deep Creek (OK620910020250_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	2,430.0	2.41E+13	0.00E+00	0.00E+00	2.17E+13	2.41E+12
5	74.1	7.36E+11	0.00E+00	0.00E+00	6.63E+11	7.36E+10
10	21.1	2.09E+11	0.00E+00	0.00E+00	1.88E+11	2.09E+10
15	12.7	1.26E+11	0.00E+00	0.00E+00	1.14E+11	1.26E+10
20	8.8	8.71E+10	0.00E+00	0.00E+00	7.84E+10	8.71E+09
25	7.0	6.97E+10	0.00E+00	0.00E+00	6.27E+10	6.97E+09
30	5.7	5.66E+10	0.00E+00	0.00E+00	5.10E+10	5.66E+09
35	4.8	4.79E+10	0.00E+00	0.00E+00	4.31E+10	4.79E+09
40	4.4	4.36E+10	0.00E+00	0.00E+00	3.92E+10	4.36E+09
45	3.9	3.92E+10	0.00E+00	0.00E+00	3.53E+10	3.92E+09
50	3.5	3.49E+10	0.00E+00	0.00E+00	3.14E+10	3.49E+09
55	3.1	3.05E+10	0.00E+00	0.00E+00	2.74E+10	3.05E+09
60	2.6	2.57E+10	0.00E+00	0.00E+00	2.31E+10	2.57E+09
65	2.3	2.31E+10	0.00E+00	0.00E+00	2.08E+10	2.31E+09
70	2.1	2.04E+10	0.00E+00	0.00E+00	1.83E+10	2.04E+09
75	1.8	1.79E+10	0.00E+00	0.00E+00	1.61E+10	1.79E+09
80	1.49	1.48E+10	0.00E+00	0.00E+00	1.33E+10	1.48E+09
85	1.23	1.22E+10	0.00E+00	0.00E+00	1.10E+10	1.22E+09
90	0.96	9.58E+09	0.00E+00	0.00E+00	8.63E+09	9.58E+08
95	0.53	5.23E+09	0.00E+00	0.00E+00	4.70E+09	5.23E+08
100	0.04	3.92E+08	0.00E+00	0.00E+00	3.53E+08	3.92E+07

Figure 5-15

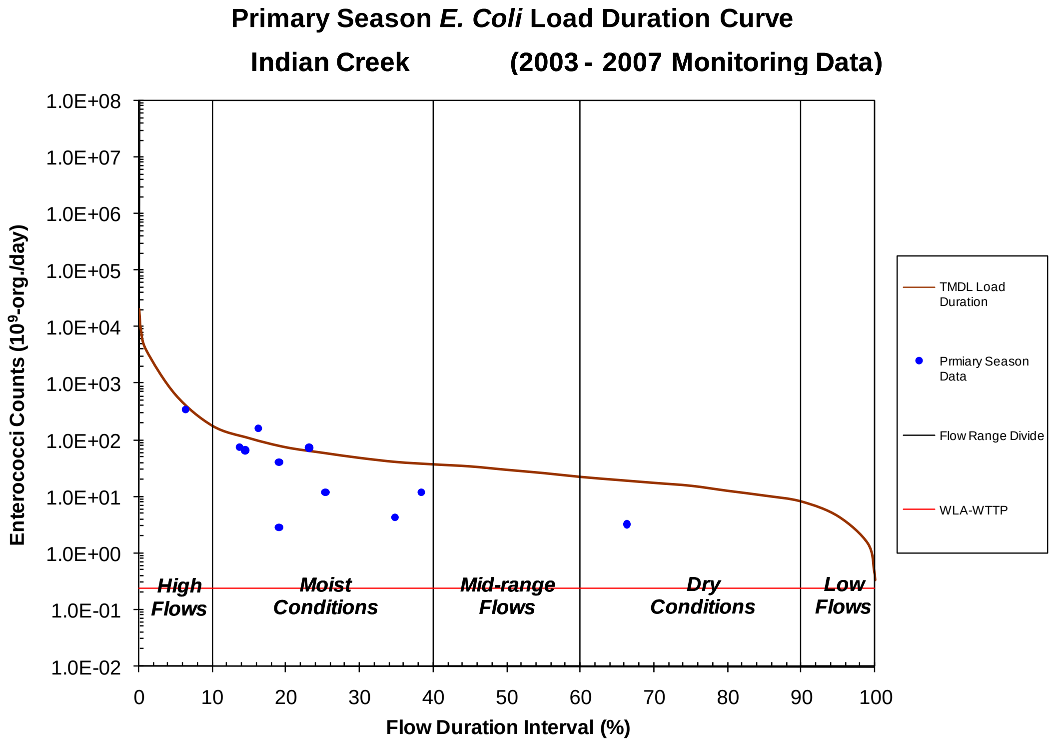


Table 5-18 *E. Coli* TMDL Calculations for Indian Creek (OK620910020310_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	2,094.2	2.08E+13	2.48E+08	0.00E+00	1.87E+13	2.08E+12
5	63.9	6.34E+11	2.48E+08	0.00E+00	5.71E+11	6.34E+10
10	18.1	1.80E+11	2.48E+08	0.00E+00	1.62E+11	1.80E+10
15	11.0	1.09E+11	2.48E+08	0.00E+00	9.77E+10	1.09E+10
20	7.6	7.51E+10	2.48E+08	0.00E+00	6.73E+10	7.51E+09
25	6.0	6.01E+10	2.48E+08	0.00E+00	5.38E+10	6.01E+09
30	4.9	4.88E+10	2.48E+08	0.00E+00	4.37E+10	4.88E+09
35	4.2	4.13E+10	2.48E+08	0.00E+00	3.69E+10	4.13E+09
40	3.8	3.75E+10	2.48E+08	0.00E+00	3.35E+10	3.75E+09
45	3.5	3.45E+10	2.48E+08	0.00E+00	3.08E+10	3.45E+09
50	3.0	3.00E+10	2.48E+08	0.00E+00	2.68E+10	3.00E+09
55	2.6	2.63E+10	2.48E+08	0.00E+00	2.34E+10	2.63E+09
60	2.3	2.25E+10	2.48E+08	0.00E+00	2.00E+10	2.25E+09
65	2.0	1.99E+10	2.48E+08	0.00E+00	1.77E+10	1.99E+09
70	1.8	1.76E+10	2.48E+08	0.00E+00	1.56E+10	1.76E+09
75	1.6	1.57E+10	2.48E+08	0.00E+00	1.39E+10	1.57E+09
80	1.29	1.28E+10	2.48E+08	0.00E+00	1.12E+10	1.28E+09
85	1.06	1.05E+10	2.48E+08	0.00E+00	9.21E+09	1.05E+09
90	0.83	8.26E+09	2.48E+08	0.00E+00	7.19E+09	8.26E+08
95	0.45	4.51E+09	2.48E+08	0.00E+00	3.81E+09	4.51E+08
100	0.03	3.38E+08	2.48E+08	0.00E+00	5.61E+07	3.38E+07

Figure 5-16

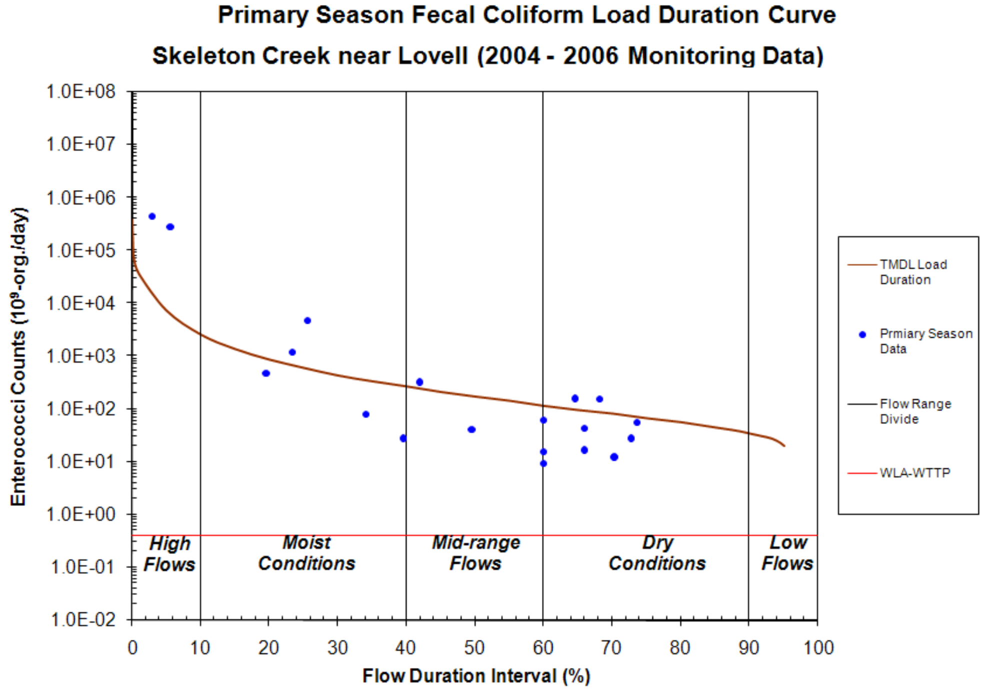


Table 5-19 Fecal Coliform TMDL Calculations for Skeleton Creek (OK620910030010_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	39,200.0	3.84E+14	4.01E+08	0.00E+00	3.45E+14	3.84E+13
5	758.0	7.42E+12	4.01E+08	0.00E+00	6.67E+12	7.42E+11
10	267.0	2.61E+12	4.01E+08	0.00E+00	2.35E+12	2.61E+11
15	142.0	1.39E+12	4.01E+08	0.00E+00	1.25E+12	1.39E+11
20	90.0	8.81E+11	4.01E+08	0.00E+00	7.92E+11	8.81E+10
25	62.8	6.14E+11	4.01E+08	0.00E+00	5.52E+11	6.14E+10
30	45.0	4.40E+11	4.01E+08	0.00E+00	3.96E+11	4.40E+10
35	35.0	3.42E+11	4.01E+08	0.00E+00	3.08E+11	3.42E+10
40	28.0	2.74E+11	4.01E+08	0.00E+00	2.46E+11	2.74E+10
45	22.0	2.15E+11	4.01E+08	0.00E+00	1.93E+11	2.15E+10
50	18.0	1.76E+11	4.01E+08	0.00E+00	1.58E+11	1.76E+10
55	15.0	1.47E+11	4.01E+08	0.00E+00	1.32E+11	1.47E+10
60	12.0	1.17E+11	4.01E+08	0.00E+00	1.05E+11	1.17E+10
65	10.0	9.79E+10	4.01E+08	0.00E+00	8.77E+10	9.79E+09
70	8.6	8.42E+10	4.01E+08	0.00E+00	7.53E+10	8.42E+09
75	7.0	6.85E+10	4.01E+08	0.00E+00	6.12E+10	6.85E+09
80	5.90	5.77E+10	4.01E+08	0.00E+00	5.16E+10	5.77E+09
85	4.70	4.60E+10	4.01E+08	0.00E+00	4.10E+10	4.60E+09
90	3.60	3.52E+10	4.01E+08	0.00E+00	3.13E+10	3.52E+09
95	2.10	2.05E+10	4.01E+08	0.00E+00	1.81E+10	2.05E+09
100	0.00	0.00E+00	4.01E+08	0.00E+00	-4.01E+08	0.00E+00

Figure 5-17

Primary Season *E. Coli* Load Duration Curve

Skeleton Creek near Lovell (2004 - 2007 Monitoring Data)

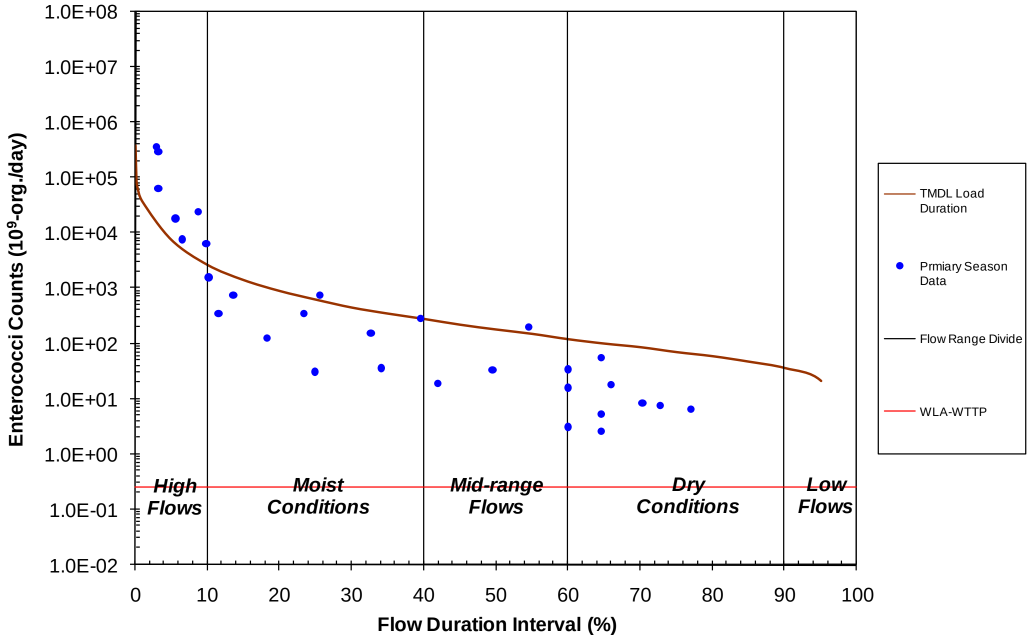


Table 5-20 *E. Coli* TMDL Calculations for Skeleton Creek (OK620910030010_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	39,200.0	3.89E+14	2.53E+08	0.00E+00	3.50E+14	3.89E+13
5	758.0	7.53E+12	2.53E+08	0.00E+00	6.78E+12	7.53E+11
10	267.0	2.65E+12	2.53E+08	0.00E+00	2.39E+12	2.65E+11
15	142.0	1.41E+12	2.53E+08	0.00E+00	1.27E+12	1.41E+11
20	90.0	8.94E+11	2.53E+08	0.00E+00	8.04E+11	8.94E+10
25	62.8	6.23E+11	2.53E+08	0.00E+00	5.61E+11	6.23E+10
30	45.0	4.47E+11	2.53E+08	0.00E+00	4.02E+11	4.47E+10
35	35.0	3.48E+11	2.53E+08	0.00E+00	3.13E+11	3.48E+10
40	28.0	2.78E+11	2.53E+08	0.00E+00	2.50E+11	2.78E+10
45	22.0	2.19E+11	2.53E+08	0.00E+00	1.96E+11	2.19E+10
50	18.0	1.79E+11	2.53E+08	0.00E+00	1.61E+11	1.79E+10
55	15.0	1.49E+11	2.53E+08	0.00E+00	1.34E+11	1.49E+10
60	12.0	1.19E+11	2.53E+08	0.00E+00	1.07E+11	1.19E+10
65	10.0	9.93E+10	2.53E+08	0.00E+00	8.91E+10	9.93E+09
70	8.6	8.54E+10	2.53E+08	0.00E+00	7.66E+10	8.54E+09
75	7.0	6.95E+10	2.53E+08	0.00E+00	6.23E+10	6.95E+09
80	5.90	5.86E+10	2.53E+08	0.00E+00	5.25E+10	5.86E+09
85	4.70	4.67E+10	2.53E+08	0.00E+00	4.18E+10	4.67E+09
90	3.60	3.58E+10	2.53E+08	0.00E+00	3.19E+10	3.58E+09
95	2.10	2.09E+10	2.53E+08	0.00E+00	1.85E+10	2.09E+09
100	0.00	0.00E+00	2.53E+08	0.00E+00	-2.53E+08	0.00E+00

Figure 5-18

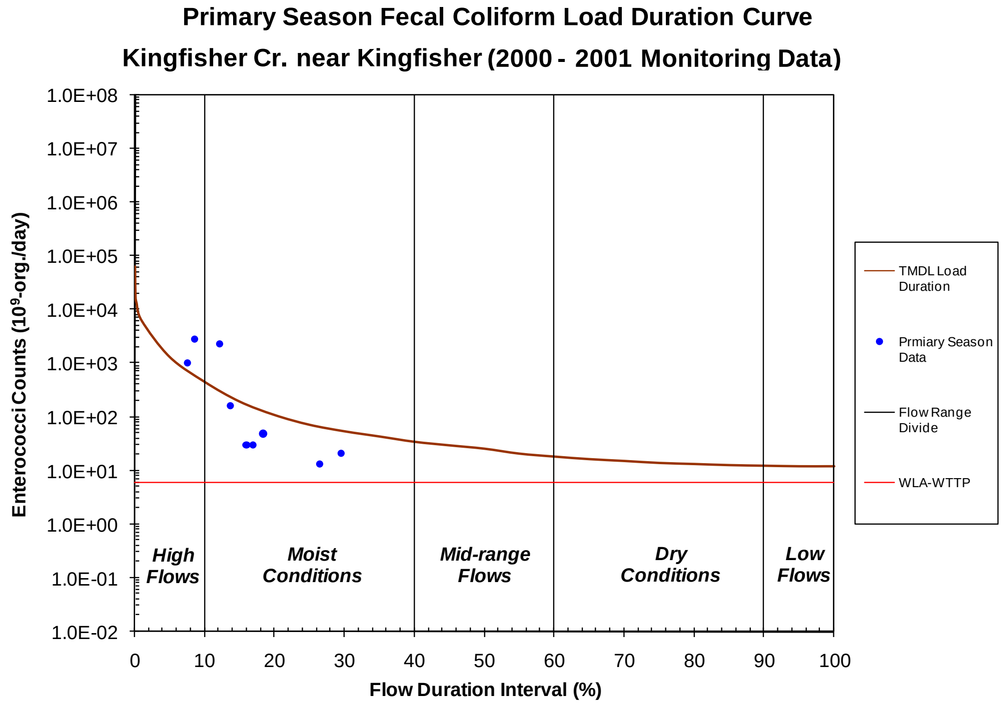


Table 5-21 Fecal Coliform TMDL Calculations for Kingfisher Creek (OK620910050010_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	6,481.2	6.34E+13	6.06E+09	0.00E+00	5.71E+13	6.34E+12
5	134.7	1.32E+12	6.06E+09	0.00E+00	1.18E+12	1.32E+11
10	46.3	4.53E+11	6.06E+09	0.00E+00	4.02E+11	4.53E+10
15	19.9	1.95E+11	6.06E+09	0.00E+00	1.69E+11	1.95E+10
20	11.2	1.09E+11	6.06E+09	0.00E+00	9.22E+10	1.09E+10
25	7.3	7.18E+10	6.06E+09	0.00E+00	5.86E+10	7.18E+09
30	5.5	5.42E+10	6.06E+09	0.00E+00	4.28E+10	5.42E+09
35	4.4	4.34E+10	6.06E+09	0.00E+00	3.30E+10	4.34E+09
40	3.5	3.46E+10	6.06E+09	0.00E+00	2.51E+10	3.46E+09
45	3.0	2.97E+10	6.06E+09	0.00E+00	2.07E+10	2.97E+09
50	2.6	2.57E+10	6.06E+09	0.00E+00	1.71E+10	2.57E+09
55	2.1	2.08E+10	6.06E+09	0.00E+00	1.27E+10	2.08E+09
60	1.9	1.83E+10	6.06E+09	0.00E+00	1.05E+10	1.83E+09
65	1.7	1.64E+10	6.06E+09	0.00E+00	8.75E+09	1.64E+09
70	1.6	1.52E+10	6.06E+09	0.00E+00	7.63E+09	1.52E+09
75	1.4	1.40E+10	6.06E+09	0.00E+00	6.52E+09	1.40E+09
80	1.36	1.34E+10	6.06E+09	0.00E+00	5.96E+09	1.34E+09
85	1.30	1.27E+10	6.06E+09	0.00E+00	5.40E+09	1.27E+09
90	1.27	1.24E+10	6.06E+09	0.00E+00	5.11E+09	1.24E+09
95	1.24	1.21E+10	6.06E+09	0.00E+00	4.84E+09	1.21E+09
100	1.24	1.21E+10	6.06E+09	0.00E+00	4.84E+09	1.21E+09

Figure 5-19

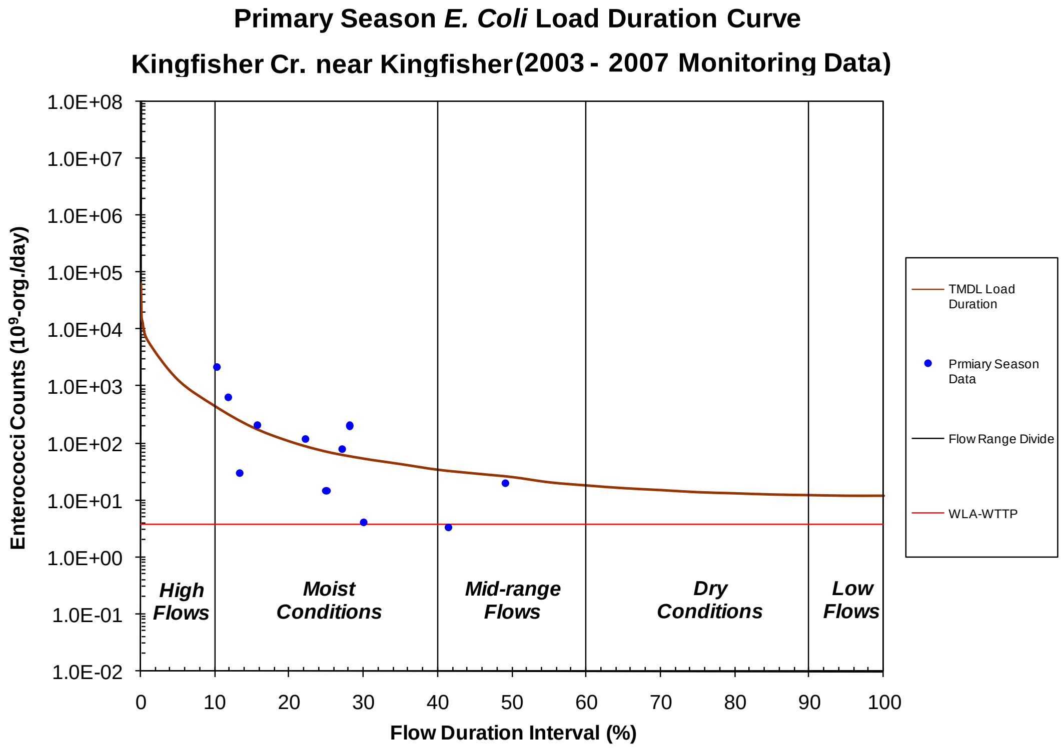


Table 5-22 *E. Coli* TMDL Calculations for Kingfisher Creek (OK620910050010_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	6,481.2	6.44E+13	3.82E+09	0.00E+00	5.79E+13	6.44E+12
5	134.7	1.34E+12	3.82E+09	0.00E+00	1.20E+12	1.34E+11
10	46.3	4.60E+11	3.82E+09	0.00E+00	4.10E+11	4.60E+10
15	19.9	1.97E+11	3.82E+09	0.00E+00	1.74E+11	1.97E+10
20	11.2	1.11E+11	3.82E+09	0.00E+00	9.59E+10	1.11E+10
25	7.3	7.29E+10	3.82E+09	0.00E+00	6.18E+10	7.29E+09
30	5.5	5.50E+10	3.82E+09	0.00E+00	4.57E+10	5.50E+09
35	4.4	4.41E+10	3.82E+09	0.00E+00	3.59E+10	4.41E+09
40	3.5	3.51E+10	3.82E+09	0.00E+00	2.78E+10	3.51E+09
45	3.0	3.02E+10	3.82E+09	0.00E+00	2.33E+10	3.02E+09
50	2.6	2.61E+10	3.82E+09	0.00E+00	1.97E+10	2.61E+09
55	2.1	2.11E+10	3.82E+09	0.00E+00	1.52E+10	2.11E+09
60	1.9	1.86E+10	3.82E+09	0.00E+00	1.29E+10	1.86E+09
65	1.7	1.67E+10	3.82E+09	0.00E+00	1.12E+10	1.67E+09
70	1.6	1.54E+10	3.82E+09	0.00E+00	1.01E+10	1.54E+09
75	1.4	1.42E+10	3.82E+09	0.00E+00	8.95E+09	1.42E+09
80	1.36	1.36E+10	3.82E+09	0.00E+00	8.38E+09	1.36E+09
85	1.30	1.29E+10	3.82E+09	0.00E+00	7.81E+09	1.29E+09
90	1.27	1.26E+10	3.82E+09	0.00E+00	7.52E+09	1.26E+09
95	1.24	1.23E+10	3.82E+09	0.00E+00	7.25E+09	1.23E+09
100	1.24	1.23E+10	3.82E+09	0.00E+00	7.25E+09	1.23E+09

Figure 5-20

Primary Season *E. Coli* Load Duration Curve

Uncle Johns Creek (2003 - 2007 Monitoring Data)

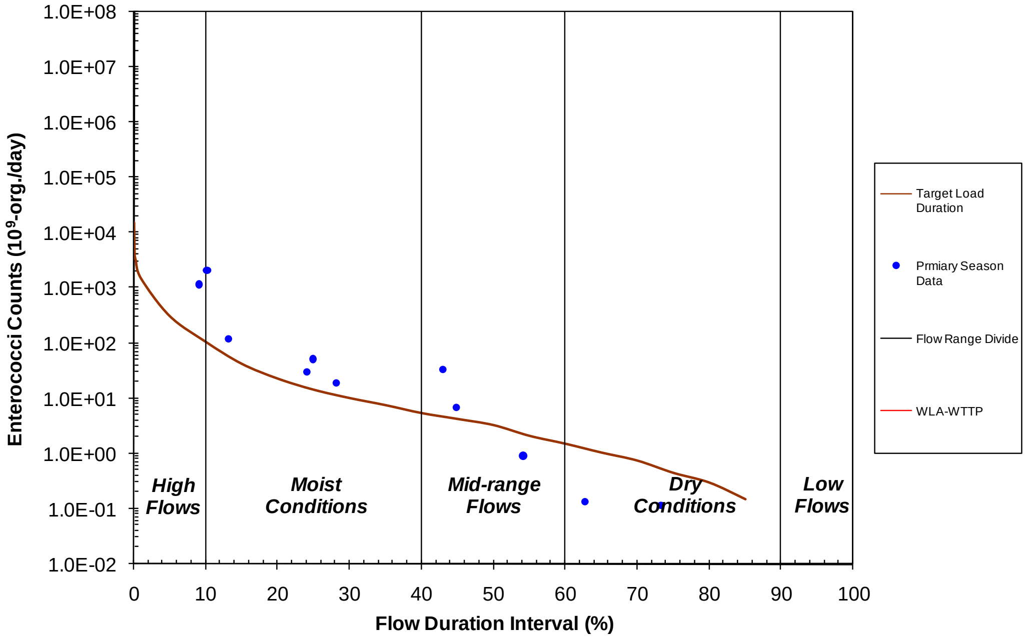


Table 5-23 *E. Coli* TMDL Calculations for Uncle Johns Creek (OK620910050030_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	6398.3	6.35E+13	0.00E+00	0.00E+00	5.72E+13	6.35E+12
5	130.0	1.29E+12	0.00E+00	0.00E+00	1.16E+12	1.29E+11
10	44.4	4.41E+11	0.00E+00	0.00E+00	3.97E+11	4.41E+10
15	17.8	1.77E+11	0.00E+00	0.00E+00	1.59E+11	1.77E+10
20	9.6	9.51E+10	0.00E+00	0.00E+00	8.56E+10	9.51E+09
25	6.0	5.98E+10	0.00E+00	0.00E+00	5.38E+10	5.98E+09
30	4.3	4.22E+10	0.00E+00	0.00E+00	3.80E+10	4.22E+09
35	3.2	3.14E+10	0.00E+00	0.00E+00	2.82E+10	3.14E+09
40	2.3	2.26E+10	0.00E+00	0.00E+00	2.03E+10	2.26E+09
45	1.8	1.77E+10	0.00E+00	0.00E+00	1.59E+10	1.77E+09
50	1.4	1.37E+10	0.00E+00	0.00E+00	1.23E+10	1.37E+09
55	0.9	8.73E+09	0.00E+00	0.00E+00	7.86E+09	8.73E+08
60	0.6	6.28E+09	0.00E+00	0.00E+00	5.65E+09	6.28E+08
65	0.4	4.35E+09	0.00E+00	0.00E+00	3.91E+09	4.35E+08
70	0.3	3.10E+09	0.00E+00	0.00E+00	2.79E+09	3.10E+08
75	0.2	1.86E+09	0.00E+00	0.00E+00	1.68E+09	1.86E+08
80	0.13	1.24E+09	0.00E+00	0.00E+00	1.12E+09	1.24E+08
85	0.06	6.21E+08	0.00E+00	0.00E+00	5.59E+08	6.21E+07
90	0.03	2.94E+08	0.00E+00	0.00E+00	2.65E+08	2.94E+07
95	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Figure 5-21

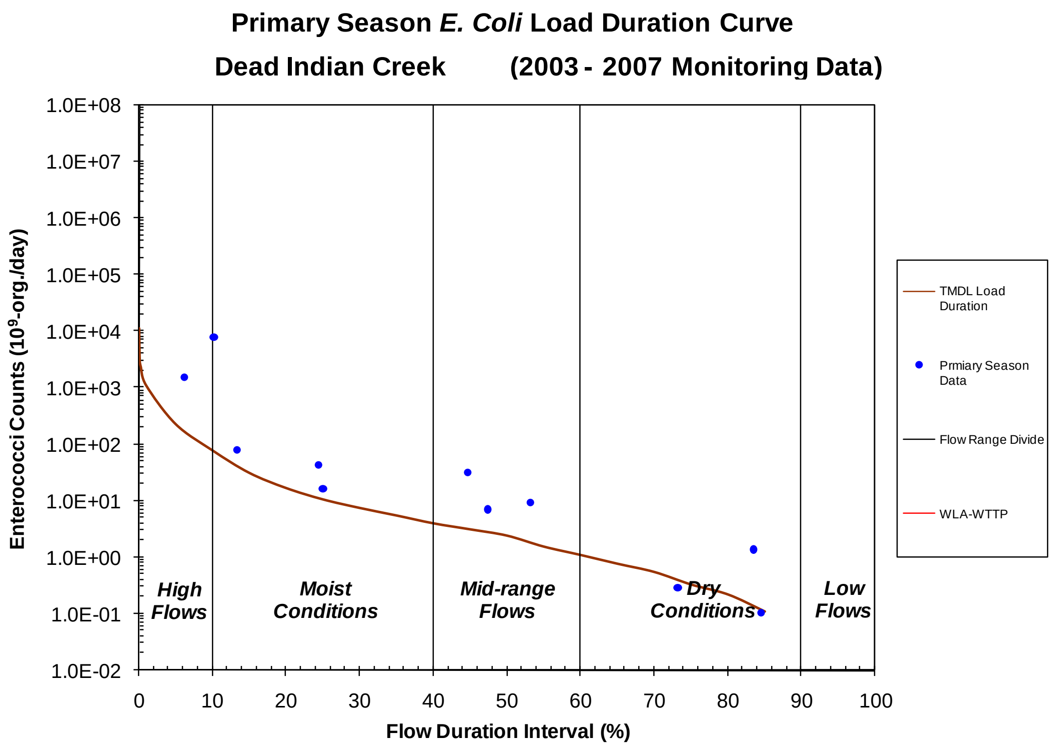


Table 5-24 *E. Coli* TMDL Calculations for Kingfisher Creek (OK620910050010_00)

Percentile	Flow (cfs)	TMDL (cfu/day)	WLA_WWTP (cfu/day)	WLA_MS4 (cfu/day)	LA (cfu/day)	MOS (cfu/day)
0	4,766	4.73E+13	0.00E+00	0.00E+00	4.26E+13	4.73E+12
5	97	9.62E+11	0.00E+00	0.00E+00	8.66E+11	9.62E+10
10	33	3.29E+11	0.00E+00	0.00E+00	2.96E+11	3.29E+10
15	13	1.31E+11	0.00E+00	0.00E+00	1.18E+11	1.31E+10
20	7	7.09E+10	0.00E+00	0.00E+00	6.38E+10	7.09E+09
25	4	4.46E+10	0.00E+00	0.00E+00	4.01E+10	4.46E+09
30	3	3.14E+10	0.00E+00	0.00E+00	2.83E+10	3.14E+09
35	2.3	2.31E+10	0.00E+00	0.00E+00	2.08E+10	2.31E+09
40	1.7	1.68E+10	0.00E+00	0.00E+00	1.51E+10	1.68E+09
45	1.3	1.31E+10	0.00E+00	0.00E+00	1.18E+10	1.31E+09
50	1.0	1.02E+10	0.00E+00	0.00E+00	9.16E+09	1.02E+09
55	0.7	6.50E+09	0.00E+00	0.00E+00	5.85E+09	6.50E+08
60	0.47	4.62E+09	0.00E+00	0.00E+00	4.16E+09	4.62E+08
65	0.33	3.24E+09	0.00E+00	0.00E+00	2.91E+09	3.24E+08
70	0.23	2.31E+09	0.00E+00	0.00E+00	2.08E+09	2.31E+08
75	0.14	1.39E+09	0.00E+00	0.00E+00	1.25E+09	1.39E+08
80	0.09	9.25E+08	0.00E+00	0.00E+00	8.32E+08	9.25E+07
85	0.05	4.62E+08	0.00E+00	0.00E+00	4.16E+08	4.62E+07
90	0.02	2.19E+08	0.00E+00	0.00E+00	1.97E+08	2.19E+07
95	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
100	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

5.8 Reasonable Assurances

ODEQ will collaborate with a host of other state agencies and local governments working within the boundaries of state and local regulations to target available funding and technical assistance to support implementation of pollution controls and management measures. Various water quality management programs and funding sources provide a reasonable assurance that the pollutant reductions as required by these TMDLs can be achieved and water quality can be restored to maintain designated uses. ODEQ's Continuing Planning Process (CPP), required by the CWA §303(e)(3) and 40 CFR 130.5, summarizes Oklahoma's commitments and programs aimed at restoring and protecting water quality throughout the state (ODEQ 2007). The CPP can be viewed from ODEQ's website at http://www.deq.state.ok.us/WQDnew/pubs/2006_CPP_final.pdf. Table 5-26 provides a partial list of the state partner agencies ODEQ will collaborate with to address point and nonpoint source reduction goals established by TMDLs.

Table 5-25 Partial List of Oklahoma Water Quality Management Agencies

Agency	Web Link
Oklahoma Conservation Commission	http://www.ok.gov/conservation/Agency_Divisions/Water_Quality_Division
Oklahoma Department of Wildlife Conservation	http://www.wildlifedepartment.com/watchabl.htm
Oklahoma Department of Agriculture, Food, and Forestry	http://www.oda.state.ok.us/aems.htm
Oklahoma Water Resources Board	http://www.owrb.ok.gov/quality/index.php

Nonpoint source pollution is managed by the Oklahoma Conservation Commission. The primary mechanisms used for management of nonpoint source pollution are incentive-based programs that support the installation of BMPs and public education and outreach. Other programs include regulations and permits for CAFOs. The CAFO Act, as administered by the ODAFF, provides CAFO operators the necessary tools and information to deal with the manure and wastewater animals produce so streams, lakes, ponds, and groundwater sources are not polluted.

As authorized by Section 402 of the CWA, the ODEQ has delegation of the NPDES Program in Oklahoma, except for certain jurisdictional areas related to agriculture and the oil and gas industry retained by State Department of Agriculture and Oklahoma Corporation Commission, for which the USEPA has retained permitting authority. The NPDES Program in Oklahoma is implemented via OAC Title 252, Chapter 606 and the Oklahoma Pollutant Discharge Elimination System (OPDES) Act and in accordance with the agreement between ODEQ and USEPA relating to administration and enforcement of the delegated NPDES Program. Implementation of point source WLAs is done through permits issued under the OPDES program.

The reduction rates called for in this TMDL report are as high as 95 percent. The ODEQ recognizes that achieving such high reductions may not be realistic, especially since unregulated nonpoint sources are a major cause of the impairment. The high reduction rates are not uncommon for pathogen-impaired waters. Similar reduction rates are often found in other pathogen TMDLs around the nation. The suitability of the current criteria for pathogens and the beneficial uses of the receiving stream should be reviewed. For example, the Kansas Department of Environmental Quality has proposed to exclude certain high flow conditions during which pathogen standards will not apply, although that exclusion was not approved by the USEPA. Additionally, USEPA has been conducting new epidemiology studies and may develop new recommendations for pathogen criteria in the near future.

Revisions to the current pathogen provisions of Oklahoma's WQSs should be considered. There are three basic approaches to such revisions that may apply.

- **Removing the PBCR use:** This revision would require documentation in a Use Attainability Analysis that the use is not existing and cannot be attained. It is unlikely that this approach would be successful since there is evidence that people do swim in these waterbodies, thus constituting an existing use. Existing uses cannot be removed.
- **Modifying application of the existing criteria:** This approach would include considerations such as an exemption under certain high flow conditions, an allowance for wildlife or "natural conditions," a sub-category of the use or other special provision for urban areas, or other special provisions for storm flows. Since large bacteria violations occur over all flow ranges, it is likely that large reductions would still be necessary. However, this approach may have merit and should be considered.
- **Revising the existing numeric criteria:** Oklahoma's current pathogen criteria are based on USEPA guidelines (See Implementation Guidance for Ambient Water Quality Criteria for Bacteria, May 2002 Draft; and Ambient Water Quality Criteria for Bacteria-1986, January 1986). However, those guidelines have received much criticism and USEPA studies that could result in revisions to their recommendations are ongoing. The use of the three indicators specified in Oklahoma's standards should be evaluated. The numeric criteria values should also be evaluated using a risk-based method such as that found in USEPA guidance.

Unless or until the WQS are revised and approved by USEPA, federal rules require that the TMDLs in this report must be based on attainment of the current standards. If revisions to the pathogen standards are approved in the future, reductions specified in these TMDLs will be re-evaluated.

SECTION 6
PUBLIC PARTICIPATION

This TMDL report was sent to other related state agencies and local government agencies for peer review and was submitted to the EPA for technical review. The report was technically approved by the EPA on July 31, 2009. A public notice was circulated to the local newspapers and/or other publications in the area affected by this TMDL on August 4, 2009. The public was given an opportunity to review the TMDL report and submit comments. The DEQ accepted written comments during a 45-day public comment period.

All written comments received became a part of the record of this TMDL. All comments were considered and responded. The TMDL report was revised according to the comments. The response to comments is included as Appendix F.

SECTION 7
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APPENDIX A
AMBIENT WATER QUALITY BACTERIA DATA – 2000 TO 2006

Appendix A

Ambient Water Quality Bacteria Data – 2000 to 2007

WQM Station	Water Body	Date	FC (#/100ml)	*E. Coli* (#/100ml)	Enter. (#/100ml)
OK620910010010-001AT	Cimarron River	6/5/2001	140	63	9000
OK620910010010-001AT	Cimarron River	6/5/2002	1800	281	1700
OK620910010010-001AT	Cimarron River	7/10/2002	400	226	180
OK620910010010-001AT	Cimarron River	8/27/2002	2000	85	150
OK620910010010-001AT	Cimarron River	9/24/2002	4000	262	2000
OK620910010010-001AT	Cimarron River	5/7/2003	10	30	100
OK620910010010-001AT	Cimarron River	5/28/2003	100	256	300
OK620910010010-001AT	Cimarron River	6/11/2003	47	1	18
OK620910010010-001AT	Cimarron River	7/1/2003	100	489	<10
OK620910010010-001AT	Cimarron River	7/8/2003	40	110	50
OK620910010010-001AT	Cimarron River	8/5/2003	20	10	60
OK620910010010-001AT	Cimarron River	8/12/2003	10	31	10
OK620910010010-001AT	Cimarron River	9/9/2003	200	52	20
OK620910010010-001AT	Cimarron River	9/16/2003	100	84	200
OK620910010010-001AT	Cimarron River	9/30/2003	1300	120	400
OK620910010010-001AT	Cimarron River	5/9/2006	110	52	20
OK620910010010-001AT	Cimarron River	5/22/2006	80	759	40
OK620910010010-001AT	Cimarron River	6/14/2006	70	759	10
OK620910010010-001AT	Cimarron River	6/26/2006	9000	2415	3609
OK620910010010-001AT	Cimarron River	7/5/2006	370	20	148
OK620910010010-001AT	Cimarron River	7/24/2006	30	50	85
OK620910010010-001AT	Cimarron River	8/7/2006	130	74	20
OK620910010010-001AT	Cimarron River	8/22/2006	50	135	63
OK620910010010-001AT	Cimarron River	10/3/2006	30	30	84
OK620910-02-0040C	Cooper Creek	7/22/2002		120	200
OK620910-02-0040C	Cooper Creek	9/3/2002		100	280
OK620910-02-0040C	Cooper Creek	10/7/2002		367	100
OK620910-02-0040C	Cooper Creek	4/1/2003		<10	30
OK620910-02-0040C	Cooper Creek	5/13/2003		50	20
OK620910-02-0040C	Cooper Creek	6/10/2003		460	860
OK620910-02-0040C	Cooper Creek	7/15/2003		40	290
OK620910-02-0040C	Cooper Creek	8/19/2003		10	40
OK620910-02-0040C	Cooper Creek	9/22/2003		30	60
OK620910-02-0040C	Cooper Creek	10/27/2003		30	20
OK620910-02-0040C	Cooper Creek	4/26/2004		470	340
OK620910-02-0040C	Cooper Creek	6/7/2004		30	65
OK620910-02-0040C	Cooper Creek	5/29/2007		900	500
OK620910-02-0040C	Cooper Creek	6/25/2007		450	1400
OK620910-02-0040C	Cooper Creek	7/23/2007		60	50
OK620910-02-0040C	Cooper Creek	7/31/2007		>10000	>10000
OK620910-02-0040C	Cooper Creek	9/18/2007		150	160
OK620910-02-0250C	Deep Creek	7/23/2002		170	340

WQM Station	Water Body	Date	FC (#/100ml)	*E. Coli* (#/100ml)	Enter. (#/100ml)
OK620910-02-0250C	Deep Creek	9/4/2002		<20	200
OK620910-02-0250C	Deep Creek	10/8/2002		1100	167
OK620910-02-0250C	Deep Creek	3/31/2003		30	50
OK620910-02-0250C	Deep Creek	5/5/2003		580	220
OK620910-02-0250C	Deep Creek	6/9/2003		1640	1060
OK620910-02-0250C	Deep Creek	7/14/2003		60	50
OK620910-02-0250C	Deep Creek	8/18/2003		640	70
OK620910-02-0250C	Deep Creek	9/23/2003		170	230
OK620910-02-0250C	Deep Creek	10/28/2003		340	310
OK620910-02-0250C	Deep Creek	4/27/2004		500	580
OK620910-02-0250C	Deep Creek	6/7/2004		55	15
OK620910-02-0250C	Deep Creek	5/30/2007		>2000	>2000
OK620910-02-0250C	Deep Creek	6/25/2007		750	1200
OK620910-02-0250C	Deep Creek	7/23/2007		150	140
OK620910-02-0250C	Deep Creek	7/30/2007		50	120
OK620910-02-0250C	Deep Creek	9/17/2007		50	110
OK620910-02-0270G	Elm Creek	5/15/2000	<100		
OK620910-02-0270G	Elm Creek	6/19/2000	1600		
OK620910-02-0270G	Elm Creek	7/24/2000	5000		
OK620910-02-0270G	Elm Creek	8/28/2000	70	10	<10
OK620910-02-0270G	Elm Creek	10/2/2000	90	20	270
OK620910-02-0270G	Elm Creek	11/6/2000	3000	712	14000
OK620910-02-0270G	Elm Creek	1/23/2001	10	<10	400
OK620910-02-0270G	Elm Creek	2/26/2001	60	86	7000
OK620910-02-0270G	Elm Creek	4/2/2001	10	41	20
OK620910-02-0270G	Elm Creek	5/8/2001	80	<10	80
OK620910-02-0270G	Elm Creek	6/12/2001	600	84	700
OK620910-02-0270G	Elm Creek	7/24/2001	>300	550	25
OK620910-02-0270G	Elm Creek	8/21/2001	255	15	1200
OK620910-02-0270G	Elm Creek	9/25/2001	90	580	310
OK620910-02-0310C	Indian Creek	7/23/2002		470	270
OK620910-02-0310C	Indian Creek	9/4/2002		<20	260
OK620910-02-0310C	Indian Creek	10/8/2002		767	67
OK620910-02-0310C	Indian Creek	3/31/2003		10	10
OK620910-02-0310C	Indian Creek	5/5/2003		<20	60
OK620910-02-0310C	Indian Creek	6/9/2003		240	520
OK620910-02-0310C	Indian Creek	7/14/2003		120	120
OK620910-02-0310C	Indian Creek	8/18/2003		70	450
OK620910-02-0310C	Indian Creek	9/23/2003		40	230
OK620910-02-0310C	Indian Creek	10/28/2003		60	120
OK620910-02-0310C	Indian Creek	4/27/2004		120	670
OK620910-02-0310C	Indian Creek	6/7/2004		85	55
OK620910-02-0310C	Indian Creek	5/30/2007		690	530
OK620910-02-0310C	Indian Creek	6/25/2007		340	920
OK620910-02-0310C	Indian Creek	7/23/2007		250	340

WQM Station	Water Body	Date	FC (#/100ml)	*E. Coli* (#/100ml)	Enter. (#/100ml)
OK620910-02-0310C	Indian Creek	7/30/2007		200	260
OK620910-02-0310C	Indian Creek	9/17/2007		470	330
OK620910030010-001AT	Skeleton Creek	6/5/2001	600	145	5000
OK620910030010-001AT	Skeleton Creek	9/24/2001	10	10	8000
OK620910030010-001AT	Skeleton Creek	2/6/2002	190		
OK620910030010-001AT	Skeleton Creek	3/13/2002	100		
OK620910030010-001AT	Skeleton Creek	4/10/2002	60		
OK620910030010-001AT	Skeleton Creek	5/15/2002	100	61	400
OK620910030010-001AT	Skeleton Creek	6/5/2002	3000	633	41000
OK620910030010-001AT	Skeleton Creek	7/10/2002	300	<10	80
OK620910030010-001AT	Skeleton Creek	8/28/2002	130	20	400
OK620910030010-001AT	Skeleton Creek	9/25/2002	700	20	2000
OK620910030010-001AT	Skeleton Creek	5/4/2004	90	41	40
OK620910030010-001AT	Skeleton Creek	6/1/2004	600	213	300
OK620910030010-001AT	Skeleton Creek	6/15/2004	200	110	900
OK620910030010-001AT	Skeleton Creek	6/21/2004	12300	9804	13200
OK620910030010-001AT	Skeleton Creek	7/6/2004	3200	512	2800
OK620910030010-001AT	Skeleton Creek	7/19/2004	30	10	40
OK620910030010-001AT	Skeleton Creek	8/9/2004	180	75	300
OK620910030010-001AT	Skeleton Creek	8/24/2004	520	31	41
OK620910030010-001AT	Skeleton Creek	9/20/2004	150	41	63
OK620910030010-001AT	Skeleton Creek	9/28/2004	60	41	41
OK620910030010-001AT	Skeleton Creek	5/9/2006	210	161	262
OK620910030010-001AT	Skeleton Creek	5/22/2006	90	74	63
OK620910030010-001AT	Skeleton Creek	6/14/2006	50	51	52
OK620910030010-001AT	Skeleton Creek	6/26/2006	700	201	839
OK620910030010-001AT	Skeleton Creek	7/5/2006	17000	1112	15531
OK620910030010-001AT	Skeleton Creek	7/24/2006	70	20	168
OK620910030010-001AT	Skeleton Creek	8/7/2006	700	520	510
OK620910030010-001AT	Skeleton Creek	8/14/2006	310	41	20
OK620910030010-001AT	Skeleton Creek	8/22/2006	40	410	740
OK620910030010-001AT	Skeleton Creek	10/3/2006	20	20	63
OK620910-03-0010F	Skeleton Creek	8/6/2002		30	20
OK620910-03-0010F	Skeleton Creek	9/4/2002		<20	40
OK620910-03-0010F	Skeleton Creek	10/1/2002		100	
OK620910-03-0010F	Skeleton Creek	3/25/2003		60	30
OK620910-03-0010F	Skeleton Creek	4/29/2003		180	80
OK620910-03-0010F	Skeleton Creek	6/2/2003		50	210
OK620910-03-0010F	Skeleton Creek	7/8/2003		<10	10
OK620910-03-0010F	Skeleton Creek	8/12/2003		<20	20
OK620910-03-0010F	Skeleton Creek	9/16/2003		70	50
OK620910-03-0010F	Skeleton Creek	10/21/2003		40	250
OK620910-03-0010F	Skeleton Creek	4/20/2004		35	30
OK620910-03-0010F	Skeleton Creek	6/2/2004		20	20
OK620910-03-0010F	Skeleton Creek	5/30/2007		8800	4400
OK620910-03-0010F	Skeleton Creek	6/26/2007		950	2250

WQM Station	Water Body	Date	FC (#/100ml)	*E. Coli* (#/100ml)	Enter. (#/100ml)
OK620910-03-0010F	Skeleton Creek	7/25/2007		70	230
OK620910-03-0010F	Skeleton Creek	7/31/2007		250	490
OK620910-03-0010F	Skeleton Creek	9/11/2007		2950	1350
OK620910-03-0010S	Skeleton Creek	8/6/2002		60	30
OK620910-03-0010S	Skeleton Creek	9/4/2002		<20	60
OK620910-03-0010S	Skeleton Creek	10/1/2002		34	**
OK620910-03-0010S	Skeleton Creek	3/25/2003		60	90
OK620910-03-0010S	Skeleton Creek	4/29/2003		80	60
OK620910-03-0010S	Skeleton Creek	6/2/2003		50	110
OK620910-03-0010S	Skeleton Creek	7/8/2003		40	80
OK620910-03-0010S	Skeleton Creek	8/12/2003		40	60
OK620910-03-0010S	Skeleton Creek	9/16/2003		80	240
OK620910-03-0010S	Skeleton Creek	10/21/2003		80	260
OK620910-03-0010S	Skeleton Creek	4/20/2004		30	75
OK620910-03-0010S	Skeleton Creek	6/2/2004		10	20
OK620910-03-0010S	Skeleton Creek	5/30/2007		1940	680
OK620910-03-0010S	Skeleton Creek	6/25/2007		600	1300
OK620910-03-0010S	Skeleton Creek	7/23/2007		190	270
OK620910-03-0010S	Skeleton Creek	7/30/2007		50	40
OK620910-03-0010S	Skeleton Creek	9/18/2007		20	270
OK620910-04-0010G	Cottonwood Creek	5/15/2000	200		
OK620910-04-0010G	Cottonwood Creek	7/24/2000	17000		
OK620910-04-0010G	Cottonwood Creek	8/28/2000	100	20	1100
OK620910-04-0010G	Cottonwood Creek	10/2/2000	10	10	340
OK620910-04-0010G	Cottonwood Creek	11/7/2000	800	345	8000
OK620910-04-0010G	Cottonwood Creek	12/12/2000	70	119	1400
OK620910-04-0010G	Cottonwood Creek	1/23/2001	190	98	3000
OK620910-04-0010G	Cottonwood Creek	2/26/2001	600	583	9000
OK620910-04-0010G	Cottonwood Creek	4/3/2001	200	565	100
OK620910-04-0010G	Cottonwood Creek	5/8/2001	800	354	3000
OK620910-04-0010G	Cottonwood Creek	6/12/2001	500	437	1700
OK620910-04-0010G	Cottonwood Creek	7/17/2001	256	218	>120
OK620910-04-0010G	Cottonwood Creek	8/21/2001	315	200	170
OK620910-04-0010G	Cottonwood Creek	10/31/2001	60	70	200
OK620910-04-0100G	Chisholm Creek	5/15/2000	400		
OK620910-04-0100G	Chisholm Creek	6/19/2000	2000		
OK620910-04-0100G	Chisholm Creek	7/24/2000	7000		
OK620910-04-0100G	Chisholm Creek	8/28/2000	100	31	50
OK620910-04-0100G	Chisholm Creek	10/2/2000	20	20	30
OK620910-04-0100G	Chisholm Creek	11/7/2000	2000	24192	86000
OK620910-04-0100G	Chisholm Creek	12/12/2000	60	85	120
OK620910-04-0100G	Chisholm Creek	1/23/2001	20	<10	20
OK620910-04-0100G	Chisholm Creek	2/26/2001	31000	15531	4000
OK620910-04-0100G	Chisholm Creek	4/3/2001	80	63	40
OK620910-04-0100G	Chisholm Creek	5/8/2001	120	52	90
OK620910-04-0100G	Chisholm Creek	6/12/2001	100	74	40

WQM Station	Water Body	Date	FC (#/100ml)	*E. Coli* (#/100ml)	Enter. (#/100ml)
OK620910-04-0100G	Chisholm Creek	7/17/2001	84	40	86
OK620910-04-0100G	Chisholm Creek	8/21/2001	335	70	55
OK620910-04-0100G	Chisholm Creek	9/25/2001	220	180	290
OK620910-04-0100G	Chisholm Creek	10/31/2001	110	60	60
OK620910-04-0120B	Deer Creek	5/15/2000	1600		
OK620910-04-0120B	Deer Creek	6/19/2000	1300		
OK620910-04-0120B	Deer Creek	7/24/2000	1300		
OK620910-04-0120B	Deer Creek	8/28/2000	100	134	400
OK620910-04-0120B	Deer Creek	10/2/2000	150	52	700
OK620910-04-0120B	Deer Creek	11/7/2000	7000	4611	32000
OK620910-04-0120B	Deer Creek	12/12/2000	30	98	1000
OK620910-04-0120B	Deer Creek	1/23/2001	90	31	700
OK620910-04-0120B	Deer Creek	2/26/2001	1000	609	13000
OK620910-04-0120B	Deer Creek	4/3/2001	40	288	300
OK620910-04-0120B	Deer Creek	5/8/2001	50	419	2000
OK620910-04-0120B	Deer Creek	6/12/2001	150	143	1100
OK620910-04-0120B	Deer Creek	7/17/2001	44	186	>120
OK620910-04-0120B	Deer Creek	8/21/2001	375	170	340
OK620910-04-0120B	Deer Creek	9/26/2001	110	60	250
OK620910-04-0120B	Deer Creek	10/31/2001	150	110	120
OK620910-05-0010G	Kingfisher Creek	5/15/2000	<100		
OK620910-05-0010G	Kingfisher Creek	6/19/2000	600		
OK620910-05-0010G	Kingfisher Creek	7/24/2000	3000		
OK620910-05-0010G	Kingfisher Creek	8/28/2000	80	<10	90
OK620910-05-0010G	Kingfisher Creek	10/2/2000	90	41	180
OK620910-05-0010G	Kingfisher Creek	11/6/2000	41000	>24192	205000
OK620910-05-0010G	Kingfisher Creek	12/11/2000	40	10	500
OK620910-05-0010G	Kingfisher Creek	1/22/2001	<10	20	180
OK620910-05-0010G	Kingfisher Creek	2/27/2001	600	469	9000
OK620910-05-0010G	Kingfisher Creek	4/2/2001	400	52	30
OK620910-05-0010G	Kingfisher Creek	5/7/2001	2000	1904	9000
OK620910-05-0010G	Kingfisher Creek	6/11/2001	300	85	180
OK620910-05-0010G	Kingfisher Creek	7/16/2001	150	28	34
OK620910-05-0010G	Kingfisher Creek	8/20/2001	150	95	55
OK620910-05-0010G	Kingfisher Creek	9/26/2001	80	10	40
OK620910-05-0010G	Kingfisher Creek	10/30/2001	60	<10	30
OK620910-05-0010J	Kingfisher Creek	7/22/2002		70	190
OK620910-05-0010J	Kingfisher Creek	9/3/2002		340	160
OK620910-05-0010J	Kingfisher Creek	10/7/2002		67	<33
OK620910-05-0010J	Kingfisher Creek	4/1/2003		360	30
OK620910-05-0010J	Kingfisher Creek	5/13/2003		550	130
OK620910-05-0010J	Kingfisher Creek	6/10/2003		480	740
OK620910-05-0010J	Kingfisher Creek	7/15/2003		30	110
OK620910-05-0010J	Kingfisher Creek	8/10/2003		310	240
OK620910-05-0010J	Kingfisher Creek	9/22/2003		40	70
OK620910-05-0010J	Kingfisher Creek	10/27/2003		30	70

WQM Station	Water Body	Date	FC (#/100ml)	*E. Coli* (#/100ml)	Enter. (#/100ml)
OK620910-05-0010J	Kingfisher Creek	4/26/2004		990	300
OK620910-05-0010J	Kingfisher Creek	6/9/2004		>500	395
OK620910-05-0010J	Kingfisher Creek	5/29/2007		800	1900
OK620910-05-0010J	Kingfisher Creek	6/25/2007		1350	1350
OK620910-05-0010J	Kingfisher Creek	7/23/2007		50	200
OK620910-05-0010J	Kingfisher Creek	7/31/2007		>2000	>2000
OK620910-05-0010J	Kingfisher Creek	9/18/2007		80	480
OK620910-05-0020G	Trail Creek	5/15/2000	<100		
OK620910-05-0020G	Trail Creek	6/19/2000	800		
OK620910-05-0020G	Trail Creek	7/24/2000	13000		
OK620910-05-0020G	Trail Creek	8/28/2000	2500	3255	7000
OK620910-05-0020G	Trail Creek	10/2/2000	460	216	21000
OK620910-05-0020G	Trail Creek	11/6/2000	900	538	19000
OK620910-05-0020G	Trail Creek	12/11/2000	50	63	1000
OK620910-05-0020G	Trail Creek	1/22/2001	20	74	600
OK620910-05-0020G	Trail Creek	2/27/2001	130	218	6000
OK620910-05-0020G	Trail Creek	4/2/2001	30	145	300
OK620910-05-0020G	Trail Creek	5/7/2001	120	63	900
OK620910-05-0020G	Trail Creek	6/11/2001	300	98	1200
OK620910-05-0020G	Trail Creek	7/17/2001	>120	>160	>120
OK620910-05-0020G	Trail Creek	8/20/2001	430	195	480
OK620910-05-0020G	Trail Creek	9/26/2001	120	20	190
OK620910-05-0020G	Trail Creek	10/30/2001	820	140	320
OK620910-05-0030C	Uncle Johns Creek	7/22/2002		110	240
OK620910-05-0030C	Uncle Johns Creek	9/3/2002		<20	40
OK620910-05-0030C	Uncle Johns Creek	10/7/2002		100	<33
OK620910-05-0030C	Uncle Johns Creek	4/1/2003		70	50
OK620910-05-0030C	Uncle Johns Creek	5/13/2003		160	135
OK620910-05-0030C	Uncle Johns Creek	6/10/2003		190	420
OK620910-05-0030C	Uncle Johns Creek	7/15/2003		40	340
OK620910-05-0030C	Uncle Johns Creek	8/19/2003		20	120
OK620910-05-0030C	Uncle Johns Creek	9/22/2003		<10	150
OK620910-05-0030C	Uncle Johns Creek	10/27/2003		110	120
OK620910-05-0030C	Uncle Johns Creek	4/26/2004		5	80
OK620910-05-0030C	Uncle Johns Creek	6/9/2004		155	595
OK620910-05-0030C	Uncle Johns Creek	5/29/2007		900	3000
OK620910-05-0030C	Uncle Johns Creek	6/25/2007		700	1350
OK620910-05-0030C	Uncle Johns Creek	7/23/2007		220	270
OK620910-05-0030C	Uncle Johns Creek	7/31/2007		>2000	>2000
OK620910-05-0030C	Uncle Johns Creek	9/18/2007		350	670
OK620910-05-0080D	Dead Indian Creek	7/22/2002		70	50
OK620910-05-0080D	Dead Indian Creek	9/3/2002		500	100
OK620910-05-0080D	Dead Indian Creek	10/7/2002		233	33
OK620910-05-0080D	Dead Indian Creek	4/1/2003		<10	30
OK620910-05-0080D	Dead Indian Creek	5/13/2003		240	330
OK620910-05-0080D	Dead Indian Creek	6/10/2003		960	960

WQM Station	Water Body	Date	FC (#/100ml)	*E. Coli* (#/100ml)	Enter. (#/100ml)
OK620910-05-0080D	Dead Indian Creek	7/15/2003		70	80
OK620910-05-0080D	Dead Indian Creek	8/19/2003		820	320
OK620910-05-0080D	Dead Indian Creek	9/22/2003		90	180
OK620910-05-0080D	Dead Indian Creek	10/27/2003		30	140
OK620910-05-0080D	Dead Indian Creek	4/26/2004		>1000	330
OK620910-05-0080D	Dead Indian Creek	6/9/2004		>500	230
OK620910-05-0080D	Dead Indian Creek	5/29/2007		360	440
OK620910-05-0080D	Dead Indian Creek	6/25/2007		950	1400
OK620910-05-0080D	Dead Indian Creek	7/23/2007		190	490
OK620910-05-0080D	Dead Indian Creek	7/31/2007		>10000	>10000
OK620910-05-0080D	Dead Indian Creek	9/18/2007		120	520
OK620910-05-0080D	Dead Indian Creek	9/18/2007		170	600

FC = fecal coliform; Enter. = Enterococci.

APPENDIX B
NPDES PERMIT DISCHARGE MONITORING REPORT DATA AND SANITARY SEWER OVERFLOW DATA

Appendix B

NPDES Permit Discharge Monitoring Report Data 1997-2007

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
OK0022811	194	217	001A	5/31/1997	74055	FC	0.838	1.159	50050	Flow
OK0022811	193	212	001A	6/30/1997	74055	FC	0.588	0.661	50050	Flow
OK0022811	192	205	001A	7/31/1997	74055	FC	0.513	0.701	50050	Flow
OK0022811	170	236	001A	8/31/1997	74055	FC	0.57	0.698	50050	Flow
OK0022811	141	176	001A	9/30/1997	74055	FC	0.528	0.616	50050	Flow
OK0022811	186	237	001A	5/31/1998	74055	FC	0.673	0.858	50050	Flow
OK0022811	180	210	001A	6/30/1998	74055	FC	0.494	0.631	50050	Flow
OK0022811	187	205	001A	7/31/1998	74055	FC	0.428	0.615	50050	Flow
OK0022811	159	190	001A	8/31/1998	74055	FC	0.406	0.514	50050	Flow
OK0022811	146	220	001A	9/30/1998	74055	FC	0.46	0.546	50050	Flow
OK0022811	165	200	001A	5/31/1999	74055	FC	0.793	1.124	50050	Flow
OK0022811	108	145	001A	6/30/1999	74055	FC	0.871	1.588	50050	Flow
OK0022811	86	180	001A	7/31/1999	74055	FC	0.705	1.086	50050	Flow
OK0022811	118	220	001A	8/31/1999	74055	FC	0.509	0.609	50050	Flow
OK0022811	129	221	001A	9/30/1999	74055	FC	0.502	0.648	50050	Flow
OK0022811	181	220	001A	5/31/2000	74055	FC	0.646	1.034	50050	Flow
OK0022811	135	206	001A	6/30/2000	74055	FC	0.971	1.801	50050	Flow
OK0022811	184	195	001A	7/31/2000	74055	FC	0.737	1.256	50050	Flow
OK0022811	171	185	001A	8/31/2000	74055	FC	0.492	0.601	50050	Flow
OK0022811	170	210	001A	9/30/2000	74055	FC	0.445	0.577	50050	Flow
OK0022811	132	180	001A	5/31/2001	74055	FC	0.841	1.441	50050	Flow
OK0022811	131	180	001A	6/30/2001	74055	FC	0.659	1.055	50050	Flow
OK0022811	171	235	001A	7/31/2001	74055	FC	0.471	0.664	50050	Flow
OK0022811	159	195	001A	8/31/2001	74055	FC	0.46	0.622	50050	Flow
OK0022811	163	195	001A	9/30/2001	74055	FC	0.604	0.937	50050	Flow
OK0022811	156	190	001A	5/31/2002	74055	FC	0.538	0.684	50050	Flow
OK0022811	176	185	001A	6/30/2002	74055	FC	0.503	0.655	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
OK0022811	158	195	001A	7/31/2002	74055	FC	0.45	0.682	50050	Flow
OK0022811	120	155	001A	8/31/2002	74055	FC	0.414	0.797	50050	Flow
OK0022811	162	195	001A	9/30/2002	74055	FC	0.556	1.289	50050	Flow
OK0022811	161	185	001A	5/31/2003	74055	FC	0.823	1.279	50050	Flow
OK0022811	128	155	001A	6/30/2003	74055	FC	0.704	1.001	50050	Flow
OK0022811	155	185	001A	7/31/2003	74055	FC	0.501	0.637	50050	Flow
OK0022811	182	220	001A	8/31/2003	74055	FC	0.556	0.78	50050	Flow
OK0022811	148	180	001A	9/30/2003	74055	FC	0.537	1.007	50050	Flow
OK0022811	166	260	001A	5/31/2004	74055	FC	0.718	0.883	50050	Flow
OK0022811	193	240	001A	6/30/2004	74055	FC	0.783	1.304	50050	Flow
OK0022811	164	220	001A	7/31/2004	74055	FC	0.618	0.987	50050	Flow
OK0022811	174	210	001A	8/31/2004	74055	FC	0.565	0.912	50050	Flow
OK0022811	192	205	001A	9/30/2004	74055	FC	0.457	0.558	50050	Flow
OK0022811	17	100	001A	5/31/2005	74055	FC	0.473	0.711	50050	Flow
OK0022811	35	234	001A	6/30/2005	74055	FC	0.604	1.117	50050	Flow
OK0022811	182	220	001A	7/31/2005	74055	FC	0.419	0.568	50050	Flow
OK0022811	64	160	001A	8/31/2005	74055	FC	0.658	1.707	50050	Flow
OK0022811	115	170	001A	9/30/2005	74055	FC	0.653	1.327	50050	Flow
OK0022811	159	232	001A	5/31/2006	74055	FC	0.476	0.782	50050	Flow
OK0022811	128	205	001A	6/30/2006	74055	FC	0.396	0.711	50050	Flow
OK0022811	159	195	001A	7/31/2006	74055	FC	0.366	0.589	50050	Flow
OK0022811	125	272	001A	8/31/2006	74055	FC	0.319	0.529	50050	Flow
OK0022811	146	160	001A	9/30/2006	74055	FC	0.37	0.452	50050	Flow
OK0022811	167	360	001A	5/31/2007	74055	FC	1.064	2.017	50050	Flow
OK0022811	182	210	001A	6/30/2007	74055	FC	1.343	2.903	50050	Flow
OK0022811	179	235	001A	7/31/2007	74055	FC	1.378	2.591	50050	Flow
OK0022811	163	230	001A	8/31/2007	74055	FC	1.085	1.868	50050	Flow
OK0022811	154	190	001A	9/30/2007	74055	FC	0.728	1.033	50050	Flow
OK0027553	13	262	001A	5/31/1997	74055	FC	5.215	7.796	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
OK0027553	23	43	001A	6/30/1997	74055	FC	4.269	6.008	50050	Flow
OK0027553	15	37	001A	7/31/1997	74055	FC	4.758	8.571	50050	Flow
OK0027553	50	71	001A	8/31/1997	74055	FC	4.54	6.914	50050	Flow
OK0027553	28	36	001A	9/30/1997	74055	FC	4.773	6.726	50050	Flow
OK0027553	115	341	001A	5/31/1998	74055	FC	4.56	7.886	50050	Flow
OK0027553	135	263	001A	6/30/1998	74055	FC	3.716	6.462	50050	Flow
OK0027553	101	230	001A	7/31/1998	74055	FC	3.008	3.408	50050	Flow
OK0027553	85	140	001A	8/31/1998	74055	FC	3	3.294	50050	Flow
OK0027553	110	355	001A	9/30/1998	74055	FC	3.069	6.515	50050	Flow
OK0027553	3	199	001A	5/31/1999	74055	FC	5.384	7.871	50050	Flow
OK0027553	15	23	001A	6/30/1999	74055	FC	5.322	8.353	50050	Flow
OK0027553	10	86	001A	7/31/1999	74055	FC	3.868	5.031	50050	Flow
OK0027553	20	47	001A	8/31/1999	74055	FC	3.494	3.968	50050	Flow
OK0027553	23	36	001A	9/30/1999	74055	FC	3.72	5.06	50050	Flow
OK0027553	15	62	001A	5/31/2000	74055	FC	3.688	5.49	50050	Flow
OK0027553	6	78	001A	6/30/2000	74055	FC	4.172	7.705	50050	Flow
OK0027553	7	19	001A	7/31/2000	74055	FC	3.64	7.6	50050	Flow
OK0027553	2	4	001A	8/31/2000	74055	FC	2.643	3.061	50050	Flow
OK0027553	2	10	001A	9/30/2000	74055	FC	2.663	4.315	50050	Flow
OK0027553	4	16	001A	5/31/2001	74055	FC	4.198	6.955	50050	Flow
OK0027553	5	8	001A	6/30/2001	74055	FC	3.195	4.492	50050	Flow
OK0027553	1	1	001A	7/31/2001	74055	FC	2.616	3.073	50050	Flow
OK0027553	3	6	001A	8/31/2001	74055	FC	2.773	3.732	50050	Flow
OK0027553	5	45	001A	9/30/2001	74055	FC	3.838	6.758	50050	Flow
OK0027553	26	61	001A	5/31/2002	74055	FC	4.154	7.13	50050	Flow
OK0027553	14	52	001A	6/30/2002	74055	FC	3.93	5.612	50050	Flow
OK0027553	10	44	001A	7/31/2002	74055	FC	3.669	6.829	50050	Flow
OK0027553	2	5	001A	8/31/2002	74055	FC	3.573	6.544	50050	Flow
OK0027553	32	49	001A	9/30/2002	74055	FC	3.693	6.083	50050	Flow
OK0027553	36	219	001A	5/31/2003	74055	FC	4.176	5.369	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
OK0027553	14	42	001A	6/30/2003	74055	FC	4.073	5.238	50050	Flow
OK0027553	69	84	001A	7/31/2003	74055	FC	3.364	4.125	50050	Flow
OK0027553	18	141	001A	8/31/2003	74055	FC	3.609	4.517	50050	Flow
OK0027553	70	363	001A	9/30/2003	74055	FC	3.629	5.08	50050	Flow
OK0027553	7	8	001A	5/31/2004	74055	FC	3.943	5.365	50050	Flow
OK0027553	8	10	001A	6/30/2004	74055	FC	4.893	6.992	50050	Flow
OK0027553	11	13	001A	7/31/2004	74055	FC	5.295	6.716	50050	Flow
OK0027553	5	7	001A	8/31/2004	74055	FC	5.238	6.922	50050	Flow
OK0027553	20	40	001A	9/30/2004	74055	FC	4.089	5.148	50050	Flow
OK0027553	8	10	001A	5/31/2005	74055	FC	4.686	6.163	50050	Flow
OK0027553	34	40	001A	6/30/2005	74055	FC	5.847	8.463	50050	Flow
OK0027553	137	160	001A	7/31/2005	74055	FC	4.687	6.885	50050	Flow
OK0027553	110	118	001A	8/31/2005	74055	FC	5.242	6.708	50050	Flow
OK0027553	130	250	001A	9/30/2005	74055	FC	4.493	5.951	50050	Flow
OK0027553	6	8	001A	5/31/2006	74055	FC	4.299	5.905	50050	Flow
OK0027553	12	38	001A	6/30/2006	74055	FC	4.32	7.024	50050	Flow
OK0027553	20	105	001A	7/31/2006	74055	FC	3.819	5.07	50050	Flow
OK0027553	22	24	001A	8/31/2006	74055	FC	3.953	5.131	50050	Flow
OK0027553	18	41	001A	9/30/2006	74055	FC	4.676	6.7	50050	Flow
OK0027553	14	46	001A	5/31/2007	74055	FC	8.134	11.226	50050	Flow
OK0027553	47	2700	001A	6/30/2007	74055	FC	8.803	12.079	50050	Flow
OK0027553	25	21	001A	7/31/2007	74055	FC	9.124	12.449	50050	Flow
OK0027553	155	6000	001A	8/31/2007	74055	FC	5.847	10.365	50050	Flow
OK0027553	4	4	001A	9/30/2007	74055	FC	5.034	6.138	50050	Flow
OK0027561	41	269	001A	5/31/1997	74055	FC	9.996	12.518	50050	Flow
OK0027561	64	77	001A	6/30/1997	74055	FC	8.89	11.911	50050	Flow
OK0027561	115	885	001A	7/31/1997	74055	FC	8.621	13.29	50050	Flow
OK0027561	62	228	001A	8/31/1997	74055	FC	9.252	12.594	50050	Flow
OK0027561	39	109	001A	9/30/1997	74055	FC	7.843	9.918	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
OK0027561	38	376	001A	5/31/1998	74055	FC	9.823	16.828	50050	Flow
OK0027561	41	95	001A	6/30/1998	74055	FC	9.83	16.683	50050	Flow
OK0027561	111	196	001A	7/31/1998	74055	FC	8.833	10.401	50050	Flow
OK0027561	72	104	001A	8/31/1998	74055	FC	8.99	10.417	50050	Flow
OK0027561	164	200	001A	9/30/1998	74055	FC	9.479	12.176	50050	Flow
OK0027561	6	13	001A	5/31/1999	74055	FC	10.16	15.842	50050	Flow
OK0027561	107	200	001A	6/30/1999	74055	FC	8.691	15.734	50050	Flow
OK0027561	26	256	001A	7/31/1999	74055	FC	7.586	10.5	50050	Flow
OK0027561	57	105	001A	8/31/1999	74055	FC	8.799	10.532	50050	Flow
OK0027561	90	214	001A	9/30/1999	74055	FC	9.349	14.478	50050	Flow
OK0027561	33	192	001A	5/31/2000	74055	FC	9.359	16.135	50050	Flow
OK0027561	64	283	001A	6/30/2000	74055	FC	9.212	13.105	50050	Flow
OK0027561	43	105	001A	7/31/2000	74055	FC	8.549	13.092	50050	Flow
OK0027561	144	238	001A	8/31/2000	74055	FC	5.721	8	50050	Flow
OK0027561	101	272	001A	9/30/2000	74055	FC	5.165	6.957	50050	Flow
OK0027561	59	199	001A	5/31/2001	74055	FC	10.255	15.334	50050	Flow
OK0027561	63	267	001A	6/30/2001	74055	FC	10.042	14.562	50050	Flow
OK0027561	43	158	001A	7/31/2001	74055	FC	8.02	11.829	50050	Flow
OK0027561	14	61	001A	8/31/2001	74055	FC	8.582	12.521	50050	Flow
OK0027561	54	487	001A	9/30/2001	74055	FC	9.379	13.312	50050	Flow
OK0027561	26	69	001A	5/31/2002	74055	FC	9.818	14.612	50050	Flow
OK0027561	34	125	001A	6/30/2002	74055	FC	9.339	12.972	50050	Flow
OK0027561	85	95	001A	7/31/2002	74055	FC	9.499	13.055	50050	Flow
OK0027561	15	52	001A	8/31/2002	74055	FC	9.509	14.446	50050	Flow
OK0027561	26	33	001A	9/30/2002	74055	FC	9.352	11.69	50050	Flow
OK0027561	6	32	001A	5/31/2003	74055	FC	9.271	16.631	50050	Flow
OK0027561	12	21	001A	6/30/2003	74055	FC	8.034	15.163	50050	Flow
OK0027561	39	46	001A	7/31/2003	74055	FC	5.618	7.585	50050	Flow
OK0027561	36	59	001A	8/31/2003	74055	FC	7.878	12.357	50050	Flow
OK0027561	7	11	001A	9/30/2003	74055	FC	8.902	12.13	50050	Flow

NPDES	Monthly Average Concentration (cfu/100ml)	Monthly Maximum Concentration (cfu/100ml)	Outfall	Report Date	Parameter Code	Parameter	Monthly Average Flow (MGD)	Monthly Maximum Flow (MGD)	Parameter Code	Parameter
OK0027561	17	48	001A	5/31/2004	74055	FC	8.569	10.991	50050	Flow
OK0027561	15	7500	001A	6/30/2004	74055	FC	10.218	17.585	50050	Flow
OK0027561	20	117	001A	7/31/2004	74055	FC	9.915	18.011	50050	Flow
OK0027561	21	136	001A	8/31/2004	74055	FC	9.929	16.753	50050	Flow
OK0027561	17	178	001A	9/30/2004	74055	FC	7.834	9.677	50050	Flow
OK0027561	31	600	001A	5/31/2005	74055	FC	9.212	12.164	50050	Flow
OK0027561	20	29000	001A	6/30/2005	74055	FC	11.388	16.064	50050	Flow
OK0027561	11	31	001A	7/31/2005	74055	FC	9.801	15.404	50050	Flow
OK0027561	25	230	001A	8/31/2005	74055	FC	10.284	15.402	50050	Flow
OK0027561	6	40	001A	9/30/2005	74055	FC	9.27	12.936	50050	Flow
OK0027561	17	3350	001A	5/31/2006	74055	FC	9.081	12.281	50050	Flow
OK0027561	6	96	001A	6/30/2006	74055	FC	9.177	11.933	50050	Flow
OK0027561	26	94	001A	7/31/2006	74055	FC	7.998	11.323	50050	Flow
OK0027561	34	317	001A	8/31/2006	74055	FC	8.151	11.685	50050	Flow
OK0027561	17	104	001A	9/30/2006	74055	FC	8.816	11.255	50050	Flow
OK0027561	13	700	001A	5/31/2007	74055	FC	16.408	20.571	50050	Flow
OK0027561	14	278	001A	6/30/2007	74055	FC	17.623	21.417	50050	Flow
OK0027561	38	3100	001A	7/31/2007	74055	FC	18.277	24.659	50050	Flow
OK0027561	10	106	001A	8/31/2007	74055	FC	13.726	17.991	50050	Flow
OK0027561	6	14	001A	9/30/2007	74055	FC	13.344	15.367	50050	Flow

ODEQ Summary of Available Reports of Sanitary Sewer Overflows

Facility Name	Date	Facility ID	Location	< or >	Amount (Gal)	Cause	Type Of Source
RINGWOOD	7/24/2007	S20910			100	RAINS	LAGOON/BASIN
KINGFISHER	2/20/1997	S20920	MH 700 BLK. W. DON BLANDING		22	RAINS	
KINGFISHER	4/11/1997	S20920	MH AT 700 BLK WEST ON BLANDING		27,000	RAINS	
KINGFISHER	3/17/1998	S20920	MH AT 12TH & SHERIDAN		1,980	RAINS	
KINGFISHER	3/17/1998	S20920	MH AT 700 BLK. OF W. DON BLANDING		3,960	RAINS	
KINGFISHER	3/17/1998	S20920	12 & DON BLANDING		21,600	RAIN	
KINGFISHER	11/1/1998	S20920	MANHOLES THROUGHOUT CITY		46,000	RAIN	
KINGFISHER	11/6/1998	S20920	200 BLK. S. 3RD		75,300	OVERFLOW	
KINGFISHER	2/16/2000	S20920	113 THOMPSON DR.		100	BLOCKAGE	
KINGFISHER	5/24/2000	S20920	12TH & SHERIDAN		2,110	RAIN	
KINGFISHER	5/24/2000	S20920	12TH & DON BLANDING		6,330	RAIN	
KINGFISHER	5/24/2000	S20920	700 BLK OF WEST DON BLANDING		16,880	RAIN	
KINGFISHER	6/25/2000	S20920	MH @ 12TH & DON BLANDING		37,706	RAIN	
KINGFISHER	6/25/2000	S20920	MH @ 800 BLK. OF CLARK		7,200	RAINFALL	
KINGFISHER	6/25/2000	S20920	MH'S AT 12TH & SHERIDAN		16,758	RAIN	
KINGFISHER	6/25/2000	S20920	MH @ 700 BLK OF WEST DON BLANDING		33,516	RAIN	
KINGFISHER	12/1/2000	S20920	MH 400 BLK OF WEST SHERIDAN	<	50	GREASE	
KINGFISHER	2/24/2001	S20920	12TH & SHERIDAN		8,595	RAIN	
KINGFISHER	2/24/2001	S20920	700 BLK W. DON BLANDING		4,297	RAIN	
KINGFISHER	10/18/2001	S20920	100 BLK E. OKLAHOMA	<	100	BLOCKS IN MH	
KINGFISHER	11/5/2001	S20920	1500 BLK. S. OAK		200	RAGS	MANHOLE
KINGFISHER	12/25/2001	S20920	1216 RIDGE CREST, N. OF BACKYARD FENCE	<	100	GREASE & RAGS	MANHOLE
KINGFISHER	5/8/2007	S20920	12TH & SHERIDAN AVE.		70,000	RAIN	MANHOLE
KINGFISHER	5/9/2007	S20920	300 BLK. WEST ADMIRE AVE.		25,000	RAIN	MANHOLE
KINGFISHER	6/27/2007	S20920	1500 BLK. SOUTH OAK ST.		5,000	RAIN	MANHOLE
KINGFISHER	6/27/2007	S20920	1300 BLK., S. MAIN ST.		15,000	RAIN	PIPE
KINGFISHER	6/27/2007	S20920	300 BLK. WEST ADMIRE AVE.		2,500	RAIN	MANHOLE
KINGFISHER	6/27/2007	S20920	400 BLK. N. 7TH ST.		3,000	RAIN	MANHOLE
KINGFISHER	6/27/2007	S20920	12TH & SHERIDAN, S.E. CORNER OF		30,000	RAIN	MANHOLE
KINGFISHER	6/30/2007	S20920	N.E. OF LIFT STATION #3		4,500,000	RAIN	PIPE
KINGFISHER	7/1/2007	S20920	WEST 100 BLK. OF FAY AVE		80	RAIN	MANHOLE

Facility Name	Date	Facility ID	Location	< or >	Amount (Gal)	Cause	Type Of Source
KINGFISHER	7/30/2007	S20920	100 BLK. OF N. 9TH ST.		5,000	RAIN	MANHOLE
KINGFISHER	7/30/2007	S20920	400 BLK. N. 7TH		6,000	RAIN	MANHOLE
KINGFISHER	7/30/2007	S20920	100 BLK. N. 12		9,000	RAIN	MANHOLE
KINGFISHER	7/30/2007	S20920	12TH & SHERIDAN AVE.		12,000	RAIN	MANHOLE
KINGFISHER	8/19/2007	S20920	"B" AVE & 2ND ST.		15,000	RAIN	MANHOLE
KINGFISHER	8/19/2007	S20920	600 BLK. W. MILES AVE.		8,000	RAIN	MANHOLE
KINGFISHER	8/19/2007	S20920	300 BLK. W. ADMIRE AVE.		9,000	RAIN	MANHOLE
KINGFISHER	8/19/2007	S20920	400 BLK. N. 7TH		5,000	RAIN	MANHOLE
KINGFISHER	8/19/2007	S20920	100 BLK. OF N. 9TH		6,000	RAIN	MANHOLE
KINGFISHER	8/19/2007	S20920	12TH & SHERIDAN AVE.		15,000	RAIN	MANHOLE
KINGFISHER	4/10/2008	S20920	12TH & SHERIDAN		30,000	RAINS	
GUTHRIE	3/18/1997	S20930	1700 E. NOBLE		200		
GUTHRIE	3/24/1997	S20930	1700 BLK. E. NOBLE		100	GREASE	
GUTHRIE	3/31/1997	S20930	WEST OF THE BRIDGE ABOUT 200 FT. S. OF COLLEGE & N. PINE		2,000	COLLAPSED LINE	
GUTHRIE	7/8/1999	S20930	SKELETON CK. W. OF MINERALS WELLS PARK		5,000	LINE BREAK	
GUTHRIE	7/11/1999	S20930				LINE COLLAPSED	
GUTHRIE	1/30/2000	S20930	1211 E. HARRISON		200	COLLAPSED LINE	
GUTHRIE	2/1/2000	S20930	2300 W. NOBEL		3,500	L.S. VALVE FAILURE	
GUTHRIE	2/10/2000	S20930	310 S. 17		100	OVERFLOW	
GUTHRIE	2/15/2000	S20930	WENTZ & SPRINGER		600	LINE CLOGGED	
GUTHRIE	3/23/2000	S20930	201 N. 13TH		750	GREASE	
GUTHRIE	3/24/2000	S20930	823 LAMPLIGHTER CT.		750	BLOCKAGE	
GUTHRIE	3/24/2000	S20930	414 S. WENTZ		500	BLOCKAGE	
GUTHRIE	3/24/2000	S20930	414 SOUTH WENTZ		500	RAGS	
GUTHRIE	3/27/2000	S20930	700 S. PINE		100	ROOTS	
GUTHRIE	3/27/2000	S20930	700 SOUTH PINE ST.		100	ROOTS	
GUTHRIE	4/3/2000	S20930	211 ORBIT DR.		100	GREASE	
GUTHRIE	4/3/2000	S20930	211 ORBON DR.		100	GREASE	
GUTHRIE	4/23/2000	S20930	COLLEGE & PINE		200	RAGS	
GUTHRIE	5/10/2000	S20930	1600 N. WENTZ		500	GREASE	
GUTHRIE	5/26/2000	S20930	E. JACKSON & N. OAK		18,000	RAINS	
GUTHRIE	6/26/2000	S20930	316 S. CAPITOL		100	CLOGGED CONNECTION	
GUTHRIE	6/29/2000	S20930	1201 W. COTTERAL		25	ROOTS	
GUTHRIE	7/6/2000	S20930	614 N. WALNUT		8,000	ROOTS	

Facility Name	Date	Facility ID	Location	< or >	Amount (Gal)	Cause	Type Of Source
GUTHRIE	8/8/2000	S20930	1606 E. COLLEGE		50	GREASE	
GUTHRIE	8/28/2000	S20930	20TH & MANSUR		150	GREASE	
GUTHRIE	9/11/2000	S20930	211 ORBIT		15	BLOCKAGE	
GUTHRIE	9/26/2000	S20930	1017 PINE BROOK		50	CLOGGED CONNECTION	
GUTHRIE	9/27/2000	S20930	211 ORBIT DR.		150	CLOGGED SERVICE CONNECTION	
GUTHRIE	10/1/2000	S20930	810 & 812 SOONER CT.		500	DEBRIS	
GUTHRIE	10/16/2000	S20930	1402 E. HARRISON		150	ROOTS	
GUTHRIE	10/17/2000	S20930	1200 BLK. E. WARNER		15	BRICKS	
GUTHRIE	10/22/2000	S20930	WALNUT & COLLEGE		275	ROOTS	
GUTHRIE	11/1/2000	S20930	2318 E. NOBLE		200	GREASE	
GUTHRIE	11/19/2000	S20930	1106 N. WALNUT		30	ROOTS	
GUTHRIE	11/20/2000	S20930	1322 N. ELM		250	ROOTS	
GUTHRIE	11/20/2000	S20930	1224 W. WARNER		15	ROOTS	
GUTHRIE	11/26/2000	S20930	211 W. ORBIT		25	ROOTS	
GUTHRIE	12/5/2000	S20930	1403 W. CLEVELAND		10	GRIT	
GUTHRIE	12/7/2000	S20930	1322 N. ELM		100	GREASE	
GUTHRIE	12/19/2000	S20930	1324 W. WASHINGTON		100	GREASE	
GUTHRIE	1/10/2001	S20930	700 BLK N. POPLAR		25	RAGS	
GUTHRIE	1/25/2001	S20930	1326 N. ELM		100	GREASE	
GUTHRIE	2/2/2001	S20930	330 S. ACADEMY		5,000	GREASE & RAGS	
GUTHRIE	2/14/2001	S20930	1026 ELMWOOD		7,000	GREASE & ROOTS	
GUTHRIE	4/17/2001	S20930	804 N. PINE		75	PAPER	
GUTHRIE	4/18/2001	S20930	408 E. ORBIT		700	RAGS & DEBRIS	
GUTHRIE	4/24/2001	S20930	804 N. PINE		50	GREASE	
GUTHRIE	7/31/2001	S20930	317 N. CYPRESS		200	ROOTS	
GUTHRIE	8/14/2001	S20930	324 E. SPRINGER		25	ROOTS	
GUTHRIE	8/24/2001	S20930	1205 WALKER DR.		15	BLEACH & ROOTS	
GUTHRIE	9/14/2001	S20930	702 N. PINE		1,500	BLOCKAGE OF GRIT	
GUTHRIE	11/22/2001	S20930	300 S. WENTZ		1,000	DEBRIS IN MH	MANHOLE
GUTHRIE	11/30/2001	S20930	720 N. PINE		500	PAPER TOWELS	
GUTHRIE	12/26/2001	S20930	316 S. CAPITOL		50	BLOCKAGE	
GUTHRIE	2/22/2002	S20930	408 S. ACADEMY		1,000	GREASE	
GUTHRIE	3/8/2002	S20930	1316 E. SPRINGER		500	GREASE	
GUTHRIE	3/29/2002	S20930	408 S. ACADEMY		100	GREASE	
GUTHRIE	4/23/2002	S20930	1410 N. BROAD		200	PAPER FROM H.S.	
GUTHRIE	5/2/2002	S20930	216 S. 16TH		75	ROOTS	

Facility Name	Date	Facility ID	Location	< or >	Amount (Gal)	Cause	Type Of Source
GUTHRIE	5/30/2002	S20930	408 S. ACADEMY		1,000	PAPER	
GUTHRIE	8/13/2002	S20930	1716 W. CLEVELAND / 1719 W. NOBLE		1,000		
GUTHRIE	11/14/2002	S20930	330 S. ACADEMY		1,000	GREASE & RAGS	
GUTHRIE	12/2/2002	S20930	2024 N. 20TH		500	GREASE	
GUTHRIE	12/15/2002	S20930	1905 E. SPRINGER			ROOTS	
GUTHRIE	12/20/2002	S20930	518 N. FIRST		200	UNKNOWN	
GUTHRIE	12/31/2002	S20930	821 E. SPRINGER		50	GREASE	
GUTHRIE	1/21/2003	S20930	1719 & 1723 W. NOBLE		1,000	GREASE	
GUTHRIE	1/24/2003	S20930	1302 W. MANSER		200	ROOTS & GREASE	
GUTHRIE	1/30/2003	S20930	200 CROOKS DR.		200	BLOCKAGE	
GUTHRIE	2/4/2003	S20930	1805 E. OKLAHOMA		100	DEBRIS	MANHOLE
GUTHRIE	2/18/2003	S20930	412 N. PINE		1,000	ROOTS & GREASE	
GUTHRIE	3/3/2003	S20930	612 N. WALNUT		2,000	ROOTS & RAGS	
GUTHRIE	3/19/2003	S20930	1600 E. NOBLE		1,000	DEBRIS	MANHOLE
GUTHRIE	3/26/2003	S20930	E. OF 821 SHO GUN IN MINERAL WELLS PARK		10,000	ROOTS	
GUTHRIE	4/10/2003	S20930	809 S. DIVISION		75	SAND	
GUTHRIE	5/12/2003	S20930	1017 PINEBROOK		200	GREASE	
GUTHRIE	6/26/2003	S20930	1006 N. OAK		500,000	LINE WASHED OUT	PIPE
GUTHRIE	6/27/2003	S20930	206 N. OAK		375,000	COLLAPSED LINE	
GUTHRIE	8/7/2003	S20930	224 W. HARRISON		25	GREASE	PIPE
GUTHRIE	8/18/2003	S20930	1102 W. WARNER		150,000	OVERFLOWED POOL	
GUTHRIE	10/2/2003	S20930	2300 W. NOBLE		350	DEBRIS	LIFT STATION
GUTHRIE	10/5/2003	S20930	1602 E. NOBLE		100,000	GREASE	MANHOLE
GUTHRIE	10/9/2003	S20930	2300 W. NOBLE		2,500	I&I	LIFT STATION
GUTHRIE	10/10/2003	S20930	1924 W. MENSER		5	ROOTS	MANHOLE
GUTHRIE	10/11/2003	S20930	415 W. ORBIT		500	ROOTS	MANHOLE
GUTHRIE	10/14/2003	S20930	120 ALLEN RD		500	GREASE & ROOTS	MANHOLE
GUTHRIE	10/22/2003	S20930	1548 W. LOGAN		15,000	ROOTS	
GUTHRIE	10/22/2003	S20930	1000 E. HARRISON		100	ROOTS	MANHOLE
GUTHRIE	10/23/2003	S20930	2122 W. HARRISON		1	ROOTS	
GUTHRIE	11/6/2003	S20930	112 N.18TH		50		MANHOLE
GUTHRIE	11/10/2003	S20930	1525 S. DIVISION		2,000	ROOTS	PIPE
GUTHRIE	11/14/2003	S20930	424 E. WASHINGTON		500	BLOCKAGE	
GUTHRIE	1/21/2004	S20930	1827 W. VILAS		100	ROOTS	MANHOLE

Facility Name	Date	Facility ID	Location	< or >	Amount (Gal)	Cause	Type Of Source
GUTHRIE	2/17/2004	S20930	1403 W. CLEVELAND		10	PAPER	MANHOLE
GUTHRIE	2/27/2004	S20930	1611 E. OKLAHOMA		1,000	BLOCKAGE	MANHOLE
GUTHRIE	3/17/2004	S20930	307 N. CAPITOL		10	BLOCKAGE	
GUTHRIE	3/24/2004	S20930	1010 E. BILAS		10	BLOCKAGE	PIPE
GUTHRIE	3/29/2004	S20930	715 N. WALNUT		400	OBSTRUCTION	MANHOLE
GUTHRIE	4/1/2004	S20930	1803 E. HARRISON		10	GREASE	
GUTHRIE	4/25/2004	S20930	708 S. DREXEL		20,000	ROOTS & RAGS	MANHOLE
GUTHRIE	5/25/2004	S20930	400 W. WARNER		1,000	BROKEN LINE	
GUTHRIE	7/12/2004	S20930	1324 W. WASHINGTON		100	BLOCKAGE	
GUTHRIE	7/23/2004	S20930	1700 BLK. E. COLLEGE		2,000	HOLE IN PIPE	PIPE
GUTHRIE	7/24/2004	S20930	1700 E. COLLEGE		1,000	BLOCKAGE	PIPE
GUTHRIE	8/5/2004	S20930	2300 W. NOBLE		2,000	RELAY OUT	LIFT STATION
GUTHRIE	9/27/2004	S20930	501 N. PINE		90	GREASE	MANHOLE
GUTHRIE	10/17/2004	S20930	1827 W. VILAS	<	100	GREASE	MANHOLE
GUTHRIE	10/19/2004	S20930	319 S. 3RD		60	ROCKS	PIPE
GUTHRIE	10/20/2004	S20930	424 E. HILL DR.		150	ROOTS	MANHOLE
GUTHRIE	11/8/2004	S20930	708 N. BROAD ST.		10	GREASE	PIPE
GUTHRIE	11/16/2004	S20930	1222 W. WARNER		105	DEBRIS	PIPE
GUTHRIE	11/26/2004	S20930	1314 E. SPRINGER		2,100	ROOTS & DEBRIS	PIPE
GUTHRIE	11/29/2004	S20930	600 N. PINE		3,500	DEBRIS	PIPE
GUTHRIE	12/8/2004	S20930	402 N. 16TH		5	DEBRIS	PIPE
GUTHRIE	12/16/2004	S20930	301 N. WENTZ		10	SPLIT SLUDGE HAULERS	
GUTHRIE	12/28/2004	S20930	921 E. NOBLE		100	GREASE	PIPE
GUTHRIE	3/16/2005	S20930	1402 W. WASHINGTON		750	RAGS & DEBRIS	PIPE
GUTHRIE	3/27/2005	S20930	423 E. LINCOLN		240	ROOTS	MANHOLE
GUTHRIE	3/28/2005	S20930	3106 W. UNIVERSITY		270	GREASE	MANHOLE
GUTHRIE	4/5/2005	S20930	1523 E. HARRISON		720	ROOTS & DEBRIS	MANHOLE
GUTHRIE	4/26/2005	S20930	201 E. HARRISON (JELSMA STADIUM)		3,600	CONTRACTOR BROKE LINE	MANHOLE
GUTHRIE	5/3/2005	S20930	3100 W. COLLEGE		120	DEBRIS	MANHOLE
GUTHRIE	5/20/2005	S20930	2900 W. UNIVERSITY		900	GREASE & RAGS	MANHOLE
GUTHRIE	6/5/2005	S20930	1025 PINEBROOK		3,000	BLOCKAGE	MANHOLE
GUTHRIE	6/6/2005	S20930	1106 E. WARNER		500	ROOTS	MANHOLE
GUTHRIE	6/9/2005	S20930	2100 W. 19		3,500	BLOCKAGE	MANHOLE
GUTHRIE	6/14/2005	S20930	905 BIRD CREEK		1,500	BLOCKAGE	MANHOLE

Facility Name	Date	Facility ID	Location	< or >	Amount (Gal)	Cause	Type Of Source
GUTHRIE	7/21/2005	S20930	1609 E. GRANT		2,700	GREASE	PIPE
GUTHRIE	8/2/2005	S20930	1025 ELMWOOD DR.		3,600	GREASE & RAGS	MANHOLE
GUTHRIE	9/15/2005	S20930	701 W. WASHINGTON		3,000	GREASE	MANHOLE
GUTHRIE	10/20/2005	S20930	1624 W. WARNER		5,200	BLOCKAGE	PIPE
GUTHRIE	10/27/2005	S20930	2024 W. MANSUR		1,000	ROOTS	MANHOLE
GUTHRIE	11/28/2005	S20930	2119 W. HARRISON		3,000	RAGS & PAPER TOWELS	MANHOLE
GUTHRIE	12/13/2005	S20930	1123 E. LINCOLN		300	ROOTS	MANHOLE
GUTHRIE	12/16/2005	S20930	1624 W. WARNER		1,000	BLOCKAGE	PIPE
GUTHRIE	12/29/2005	S20930	100 S. WENTZ		1,800	GREASE	PIPE
GUTHRIE	1/19/2006	S20930	1800 E. SPRINGER		600	RAGS	MANHOLE
GUTHRIE	1/24/2006	S20930	1624 W. WARNER		600	BLOCKAGE	PIPE
GUTHRIE	2/1/2006	S20930	900 W. NOBLE		9,000	CONTRACTOR ERROR	PIPE
GUTHRIE	2/8/2006	S20930	800 W. NOBLE		600	DEBRIS	MANHOLE
GUTHRIE	2/22/2006	S20930	424 E. WASHINGTON		150	ROOTS	PIPE
GUTHRIE	2/24/2006	S20930	2521 W. ORBIT		500	RAGS	MANHOLE
GUTHRIE	2/27/2006	S20930	415 E. COLLEGE		500	RAGS	MANHOLE
GUTHRIE	3/30/2006	S20930	1517 W. NOBLE		700	GREASE	PIPE
GUTHRIE	3/31/2006	S20930	1601 W. NOBLE			GREASE	PIPE
GUTHRIE	3/31/2006	S20930	13TH & CLEVELAND		2,000	GREASE	MANHOLE
GUTHRIE	4/10/2006	S20930	1900 E. NOBLE		600	GREASE	MANHOLE
GUTHRIE	4/13/2006	S20930	1210 MAGNOLIA CIR.		100	CLOGGED LINE	
GUTHRIE	4/18/2006	S20930	1908 CLEVELAND		500	CLOTHES IN LINE	PIPE
GUTHRIE	5/19/2006	S20930	700 E. INDUSTRIAL		1,650	ROOTS	MANHOLE
GUTHRIE	7/22/2006	S20930	LOGAN COUNTY FAIRGROUNDS		2,000	L.S. FAILURE	MANHOLE
GUTHRIE	7/31/2006	S20930	6TH & WASHINGTON		300	GRIT IN LINE	
GUTHRIE	8/3/2006	S20930	LOGAN CO. FAIRGROUNDS		300	CIRCUIT BREAKER FAILED	LIFT STATION
GUTHRIE	8/13/2006	S20930	1324 W. WASHINGTON		60	RAGS	
GUTHRIE	9/5/2006	S20930	2300 WEST NOBLE		15,000	BROKEN MAIN	
GUTHRIE	9/19/2006	S20930	1220 W. CLEVELAND		100	BLOCKAGE	PIPE
GUTHRIE	10/16/2006	S20930	1215 PIN OAK		1,000	ROOTS	PIPE
GUTHRIE	11/19/2006	S20930	215 FAIRGROUNDS RD.		20,000	POWER FAILURE	LIFT STATION
GUTHRIE	11/22/2006	S20930	215 FAIRGROUNDS RD.		1,500	LIFT STATION FAILURE	LIFT STATION
GUTHRIE	12/18/2006	S20930	1418 N. ELM		200	GREASE	
GUTHRIE	12/27/2006	S20930	1402 E. HARRISON		5,000	GREASE & GRIT	
GUTHRIE	1/13/2007	S20930	610 N. WALNUT		2,000	RAGS	
GUTHRIE	1/16/2007	S20930	715 S. CHERRY		100	GREASE & GRIT	

Facility Name	Date	Facility ID	Location	< or >	Amount (Gal)	Cause	Type Of Source
GUTHRIE	2/2/2007	S20930	1210 W. NOBLE		600	GREASE	
GUTHRIE	3/15/2007	S20930	19TH & COLLEGE		100	CONTRACTOR ERROR	
GUTHRIE	3/16/2007	S20930	1116 N. WALNUT		100	ROOTS	
GUTHRIE	3/23/2007	S20930	120 E. SPRINGER (SQUIRES FIELD)		20	RAGS	
GUTHRIE	3/26/2007	S20930	700 NORTH WALNUT		400	CLOGGED MAIN	
GUTHRIE	3/28/2007	S20930	6TH & WASHINGTON		200	ROOTS	
GUTHRIE	4/12/2007	S20930	423 W. NOBLE		5,000	COLLAPSED MAIN	
GUTHRIE	4/13/2007	S20930	923 E. SPRINGER		100	CLOGGED MAIN	
GUTHRIE	4/23/2007	S20930	1809 S. DIVISION		800	RAGS & DEBRIS	
GUTHRIE	4/24/2007	S20930	1809 S. ROSS		100	SEWER COLLAPSED	
GUTHRIE	6/19/2007	S20930	3415 W. COLLEGE		50,000	OVERFLOW	
GUTHRIE	6/19/2007	S20930	2305 W. NOBLE		50,000	I&I	
GUTHRIE	6/24/2007	S20930	904 BIRD CR.		5,000	COLLAPSED MAIN	MANHOLE
GUTHRIE	6/28/2007	S20930	400 NORTH DREXEL		200	DEBRIS	
GUTHRIE	7/9/2007	S20930	211 W. ORBIT		20	DEBRIS	
GUTHRIE	7/11/2007	S20930	400 N. DREXEL		200	DEBRIS	
GUTHRIE	7/13/2007	S20930	9TH & NOBLE		50	DEBRIS	MANHOLE
GUTHRIE	8/19/2007	S20930	3415 W. COLLEGE		50,000	I&I	
GUTHRIE	8/19/2007	S20930	2305 W. OKLAHOMA		50,000	I&I	
GUTHRIE	8/19/2007	S20930	904 BIRD CREEK		8,000	RAGS & GREASE	
GUTHRIE	8/19/2007	S20930	215 FAIRGROUNDS RD.		25,000	I&I	
GUTHRIE	8/19/2007	S20930	211 W. ORBIT		50	RAGS & GREASE	
GUTHRIE	9/24/2007	S20930	821 SHOGUN DR.		12,000	MAIN BREAK	
GUTHRIE	9/29/2007	S20930	13TH & NOBLE		600	BLOCKAGE	MANHOLE
GUTHRIE	10/3/2007	S20930	1611 E. OKLAHOMA		300	BLOCKAGE	
GUTHRIE	10/3/2007	S20930	823 W. NOBLE		2,000	COLAPSED MAIN	
GUTHRIE	10/4/2007	S20930	1124 N. WALNUT		300	BLOCKAGE	
GUTHRIE	10/8/2007	S20930	120 W. ALLEN RD.		40	GREASE & PAPER	MANHOLE
GUTHRIE	10/10/2007	S20930	1100 N. BROADWAY		15,000	BROKEN MAIN	
GUTHRIE	10/11/2007	S20930	1517 S. DIVISION		30	GREASE & PAPER	
GUTHRIE	11/5/2007	S20930	2323 TERRITORIAL TRAIL		50		
GUTHRIE	11/5/2007	S20930	720 N. BROAD		50		
GUTHRIE	11/13/2007	S20930	211 W. ORBIT		5	GREASE & RAGS	MANHOLE
GUTHRIE	11/20/2007	S20930	211 W. ORBIT		5	PAPER TOWELS & RAGS	MANHOLE
GUTHRIE	1/6/2008	S20930	1207 PIN OAK		50	UNKNOWN	
GUTHRIE	1/11/2008	S20930	1809 S. DIVISION		50	GREASE	

Facility Name	Date	Facility ID	Location	< or >	Amount (Gal)	Cause	Type Of Source
GUTHRIE	1/14/2008	S20930	211 W. ORBIT DR.		10	COLLAPSED MAIN	
GUTHRIE	2/12/2008	S20930	1809 S. DIVISION		600	GREASE	MANHOLE
GUTHRIE	2/13/2008	S20930	1809 S. DIVISION		200	GREASE	
GUTHRIE	3/21/2008	S20930	1809 S. DIVISION		300	DEBRIS	
GUTHRIE	3/22/2008	S20930	1809 S. DIVISION		800	DEBRIS	
GUTHRIE	3/25/2008	S20930	823 W. NOBLE		800	GREASE	
GUTHRIE	5/13/2008	S20930	JAMES WAY IN MISSION HILLS		300	MALFUNCTION IN L.S.	MANHOLE
GUTHRIE	5/13/2008	S20930	823 E. NOBLE		2,000		
GUTHRIE	7/14/2008	S20930	823 W. NOBLE		500	GREASE	
GUTHRIE	9/30/2008	S20930	WWTP		20	LEAK IN PIPE	
GUTHRIE	10/20/2008	S20930	1109 PIN OAK DR.		5	UNKNOWN	
GUTHRIE	11/7/2008	S20930	1809 S. DIVISION		200	BLOCKAGE	
GUTHRIE	12/24/2008	S20930	120 W. ALLEN RD.		500	BLOCKAGE	MANHOLE
GUTHRIE	12/30/2008	S20930	1801 WEHR DR.		200	LARGE ROCK	
GUTHRIE	1/5/2009	S20930	120 ALLEN RD		3,000	GREASE & SILT	
GUTHRIE	1/8/2009	S20930	319 S. 3RD		30	BLOCKAGE	
GUTHRIE	1/12/2009	S20930	1224 E. NOBLE		3,000	BLOCKAGE	MANHOLE
GUTHRIE	1/20/2009	S20930	2203 E. OKLAHOMA		200	CONTRACTOR ERROR	
GUTHRIE	1/29/2009	S20930	1100 N. BROAD		100	GREASE & ROOTS	MANHOLE
GUTHRIE	1/29/2009	S20930	1308 N. BROAD		10	ROOTS	
GUTHRIE	3/2/2009	S20930	330 ACADEMY RD.		2,500	PAPER	
GUTHRIE	5/11/2009	S20930	1015 MOCKINGBIRD RD.		50	ROOTS	
GUTHRIE	6/5/2009	S20930	206 N. 13TH		10	UNKNOWN	MANHOLE
COVINGTON	5/7/1998	S20936	LAGOONS			RAIN	
COVINGTON	11/2/1998	S20936	LAGOON ON S.W. SIDE OF TOWN			RAINFALL	
COVINGTON	3/10/1999	S20936	TOWN LAGOONS	>	4,000,000	RAINS	
COVINGTON	5/1/1999	S20936	LAGOON			LAGOONS FULL	
COVINGTON	4/12/2001	S20936	LAGOON			PITS FULL	LAGOON/BASIN
COVINGTON	11/1/2002	S20936	S.W. OF TOWN		605,200	RAIN	LAGOON/BASIN
COVINGTON	11/1/2002	S20936	LAGOON			RAIN	LAGOON/BASIN
COVINGTON	11/1/2002	S20936	LAGOON			RAIN	LAGOON/BASIN
COVINGTON	11/1/2002	S20936	S.W. OF TOWN			RAIN	
COVINGTON	5/30/2007	S20936				RAINS	PIPE
OKC - DEER CREEK	1/27/1997	S20970	11516 BUCKINGHAM CT.		492		
OKC - DEER CREEK	3/29/1997	S20970	8304 N.W. 117		100		

Facility Name	Date	Facility ID	Location	< or >	Amount (Gal)	Cause	Type Of Source
OKC - DEER CREEK	4/13/1997	S20970	11104 - 11112 N.W. 116		500		
OKC - DEER CREEK	2/8/1998	S20970	8029 N.W. 114		25	BLOCKAGE	
OKC - DEER CREEK	3/16/1998	S20970	BACKWASH BASIN AT PLANT		500,000	HYDRAULIC OVERLOAD	
OKC - DEER CREEK	5/21/1998	S20970	11209 FOLKSTONE		2,500,000	BLOCKAGE	
OKC - DEER CREEK	5/30/1998	S20970	6717 STONEYBROOK DR.		75	BLOCKAGE	
OKC - DEER CREEK	7/7/1998	S20970	11145 COLECHESTER		1,000	BROKEN MAIN	
OKC - DEER CREEK	7/23/1998	S20970	N.W. EXPRESSWAY & MUSTANG		9,000	MAIN BLOCKAGE	
OKC - DEER CREEK	7/27/1998	S20970	7200 N. MANTLE		60		
OKC - DEER CREEK	9/26/1998	S20970	6217 N. KINSTON		600	BLOCKAGE	
OKC - DEER CREEK	9/26/1998	S20970	6905 N. ST. CLAIR		600	BLOCKAGE	
OKC - DEER CREEK	10/17/1998	S20970	6905 N. ST. CLAIR		400	BLOCKAGE	
OKC - DEER CREEK	11/1/1998	S20970	6315 N. MERIDIAN		15	OVERFLOW	
OKC - DEER CREEK	11/14/1998	S20970	2820 N.W. 115 PL		3,000	OVERFLOW	
OKC - DEER CREEK	11/25/1998	S20970	11743 SPRINGHOLLOW RD.		4,020	MAIN STOPPAGE	
OKC - DEER CREEK	12/21/1998	S20970	8531 N. ROCKWELL		760	BLOCKAGE	
OKC - DEER CREEK	12/25/1998	S20970	N.E. CORNER OF N.W. 92 & MACARTHUR		2,280	BLOCKAGE	
OKC - DEER CREEK	3/13/1999	S20970	2605 S.W. 46		820	BLOCKAGE	
OKC - DEER CREEK	3/16/1999	S20970	6437 N. COLLEGE		1,000	BLOCKAGE	
OKC - DEER CREEK	6/20/1999	S20970	9009 LANSBROOK LN		200	BLOCKAGE	
OKC - DEER CREEK	7/10/1999	S20970	7404 RUMSEY RD.		200	L.S. MALFUNCTION	
OKC - DEER CREEK	7/14/1999	S20970	4000 N.W. 16		2,400	MAIN COLLAPSED	
OKC - DEER CREEK	8/10/1999	S20970	5600 W. WILSHIRE		160	BLOCKAGE	

Facility Name	Date	Facility ID	Location	< or >	Amount (Gal)	Cause	Type Of Source
OKC - DEER CREEK	8/11/1999	S20970	2701 N.W. 121		10	BLOCKAGE	
OKC - DEER CREEK	8/15/1999	S20970	6300 WINDFIELD DR.		150	BLOCKAGE	
OKC - DEER CREEK	11/14/1999	S20970	8701 CANDLEWOOD DR.		100	BLOCKAGE	
OKC - DEER CREEK	12/11/1999	S20970	2606 WARWICK DR.		6	BLOCKAGE	
OKC - DEER CREEK	12/12/1999	S20970	6217 LANSBROOK LN.		6	BLOCKAGE	
OKC - DEER CREEK	12/31/1999	S20970	11629 KINGS CIR.		150	BLOCKAGE	
OKC - DEER CREEK	2/3/2000	S20970	3129 BROOKHOLLOW RD.		1,560	BLOCKAGE	
OKC - DEER CREEK	5/21/2000	S20970	8320 N.W. 114		50	BLOCKAGE	
OKC - DEER CREEK	7/2/2000	S20970	6315 N. MERIDIAN		12,000	MAIN OVERLOAD	
OKC - DEER CREEK	7/6/2000	S20970	11353 WINDMILL RD		645	BLOCKAGE	
OKC - DEER CREEK	7/8/2000	S20970	8208 N.W. 114		720	BLOCKAGE	
OKC - DEER CREEK	8/2/2000	S20970	N.W. EXPRESSWAY & MUSTANG RD.		40	BLOCKAGE	
OKC - DEER CREEK	12/3/2000	S20970	11317 MARKWELL DR.		30	BLOCKAGE	
OKC - DEER CREEK	12/23/2000	S20970	9300 N. ROCKWELL		40	BLOCKAGE	
OKC - DEER CREEK	1/21/2001	S20970	7617 N.W. 102		6	BLOCKAGE	
OKC - DEER CREEK	2/14/2001	S20970	20600 N. PORTLAND		2,000	PUMP FAILURE	
OKC - DEER CREEK	2/14/2001	S20970			2,000	HOSE LOOSE FROM PUMP	
OKC - DEER CREEK	6/28/2001	S20970	7512 BROOKSIDE DR		1,000	BLOCKAGE	
OKC - DEER CREEK	10/26/2001	S20970	N.W. 138TH & PARKWAY COMMON DR.		150	COLLAPSED MAIN	
OKC - DEER CREEK	11/14/2001	S20970	3820 N.W. 67		50	BLOCKAGE	
OKC - DEER CREEK	2/11/2002	S20970	6400 WEDGEWOOD DR.		2,400	BLOCKAGE	MANHOLE
OKC - DEER CREEK	3/3/2002	S20970	6201 KINGSTON RD.		1,060	BLOCKAGE	MANHOLE

Facility Name	Date	Facility ID	Location	< or >	Amount (Gal)	Cause	Type Of Source
OKC - DEER CREEK	3/7/2002	S20970	19200 N. MERIDIAN		30,000	MAIN BREAK	
OKC - DEER CREEK	3/9/2002	S20970	11325 EAGLE LN.		60	BLOCKAGE	
OKC - DEER CREEK	3/11/2002	S20970	19200 N. MERIDIAN		30,000	MAIN BREAK	
OKC - DEER CREEK	3/12/2002	S20970	19200 N. MERIDIAN		30,000	MAIN BREAK	PIPE
OKC - DEER CREEK	3/13/2002	S20970	19200 N. MERIDIAN		400	BLOWN GASKET	
OKC - DEER CREEK	3/23/2002	S20970	7217 WALNUT CR.		40	BLOCKAGE	
OKC - DEER CREEK	5/13/2002	S20970	7512 BROOKSIDE DR.		50	STOPPAGE	MANHOLE
OKC - DEER CREEK	5/18/2002	S20970	8901 KIMBERLY RD.		5,080	PAPER & STICKS	MANHOLE
OKC - DEER CREEK	6/14/2002	S20970	3913 N.W. 70		120	HOUSELINE FELL IN SEWER MAIN	
OKC - DEER CREEK	6/15/2002	S20970	11813 BEVENSHIRE RD.		400	BLOCKAGE	
OKC - DEER CREEK	7/14/2002	S20970	13056 BURLINGAME AVE.		300	ROOTS	MANHOLE
OKC - DEER CREEK	7/23/2002	S20970	6028 N. MERIDIAN		60	BLOCKAGE	MANHOLE
OKC - DEER CREEK	7/30/2002	S20970	4800 S. LAKE HEFNER DR.		300	FAULTY VALVE	MANHOLE
OKC - DEER CREEK	8/4/2002	S20970	6301 N. ANN ARBOR		60	BLOCKAGE	MANHOLE
OKC - DEER CREEK	9/30/2002	S20970	8001 N.W. 129 CIR		150	LEAK IN AIR VAC	
OKC - DEER CREEK	10/14/2002	S20970	5901 GAELIA DR.		60	BLOCKAGE	MANHOLE
OKC - DEER CREEK	10/25/2002	S20970	6205 OLDE HARWICK CIR.		50	ROOTS	MANHOLE
OKC - DEER CREEK	10/28/2002	S20970	8905 KENSINGTON DR.		300	ROOTS & STICKS	MANHOLE
OKC - DEER CREEK	11/25/2002	S20970	12540 N. MAY AVE.		2,000	GREASE & RAGS	MANHOLE
OKC - DEER CREEK	12/7/2002	S20970	8320 N.W. 111TH TERR.		60	GREASE	MANHOLE
OKC - DEER CREEK	12/10/2002	S20970	11732 BLUE MOON AVE.		200	GREASE	MANHOLE
OKC - DEER CREEK	12/15/2002	S20970	N. MAY & QUAIL SPRINGS PKWY.		1,500	GREASE, RAGS & PAPER	MANHOLE

Facility Name	Date	Facility ID	Location	< or >	Amount (Gal)	Cause	Type Of Source
OKC - DEER CREEK	1/2/2003	S20970	7512 BROOKSIDE DR.		30	BLOCKAGE	MANHOLE
OKC - DEER CREEK	1/13/2003	S20970	N.W. 36TH & OVERHOLSER DR.		2,000	MECHANICAL FAILURE	LIFT STATION
OKC - DEER CREEK	1/19/2003	S20970	6407 BLUE STEM WEST RD.		200	STOPPAGE	MANHOLE
OKC - DEER CREEK	3/6/2003	S20970	7526 N.W. 113 PL.		121	BLOCKAGE	MANHOLE
OKC - DEER CREEK	3/13/2003	S20970	12128 MORTIZ CT.		1,500	BLOCKAGE	MANHOLE
OKC - DEER CREEK	4/8/2003	S20970	2749 INDIAN CREEK BLVD.		200	BLOCKAGE	MANHOLE
OKC - DEER CREEK	4/13/2003	S20970	13040 BURLINGAME AVE.		300	GREASE & ROOTS	MANHOLE
OKC - DEER CREEK	6/17/2003	S20970	LAKE HEFNER & WILSHIRE BLVD. - LAKE HEFNER GOLF COURSE		100	BLOCKAGE	MANHOLE
OKC - DEER CREEK	7/15/2003	S20970	7000 W. BRITTON RD.		200	BLOCKAGE	MANHOLE
OKC - DEER CREEK	11/28/2003	S20970	8313 N.W. 105 TERR.		30	BLOCKAGE	MANHOLE
OKC - DEER CREEK	12/13/2003	S20970	8520 ARLINGTON DR.		250	BLOCKAGE	MANHOLE
OKC - DEER CREEK	12/22/2003	S20970	N.W. 99TH & KAY RIDGE		200	STOPPAGE	MANHOLE
OKC - DEER CREEK	1/2/2004	S20970	7512 BROOKSIDE DR.		30	GREASE & ROOTS	MANHOLE
OKC - DEER CREEK	1/12/2004	S20970	2800 N.W. 154		100	BLOCKAGE	MANHOLE
OKC - DEER CREEK	2/7/2004	S20970	8025 WILLOW CREEK		4,950	BLOCKAGE	MANHOLE
OKC - DEER CREEK	2/14/2004	S20970	9005 N. MACARTHUR TER.		228	TRASH	MANHOLE
OKC - DEER CREEK	2/21/2004	S20970	8300 N.W. 102		530	SLUDGE	MANHOLE
OKC - DEER CREEK	3/3/2004	S20970	940 N. BRADLEY		20	BLOCKAGE	MANHOLE
OKC - DEER CREEK	3/6/2004	S20970	11516 BUCKINGHAM CT.		350	GREASE	MANHOLE
OKC - DEER CREEK	4/13/2004	S20970	6205 OLDE HARWICK CIR.		3,480	DEBRIS	MANHOLE
OKC - DEER CREEK	6/21/2004	S20970	SLUDGE HOLDING TANK		750	MALFUNCTION	
OKC - DEER CREEK	7/15/2004	S20970	N.W. 178TH & MERIDIAN		500,000	LINE BREAK BY CONTRACTOR	PIPE

Facility Name	Date	Facility ID	Location	< or >	Amount (Gal)	Cause	Type Of Source
OKC - DEER CREEK	9/20/2004	S20970	8905 KENSINGTON RD.		100	BLOCKAGE	MANHOLE
OKC - DEER CREEK	9/21/2004	S20970	2912 N.W. 122		80	BLOCKAGE	MANHOLE
OKC - DEER CREEK	11/4/2004	S20970	11903 SHADY TRAIL LN.		10	BLOCKAGE	MANHOLE
OKC - DEER CREEK	11/9/2004	S20970	N.W. 122ND & MERIDIAN		60	BLOCKAGE	MANHOLE
OKC - DEER CREEK	12/9/2004	S20970	11719 SHASTA LN.		198	BLOCKAGE	MANHOLE
OKC - DEER CREEK	2/8/2005	S20970	6601 N. SHAWNEE		25	GREASE, SLUDGE & PAPER	MANHOLE
OKC - DEER CREEK	2/19/2005	S20970	6001 KINGSBRIAR DR.		45	BLOCKAGE	MANHOLE
OKC - DEER CREEK	3/10/2005	S20970	N.W. 122 & PONY RD.		100	BLOCKAGE	MANHOLE
OKC - DEER CREEK	3/23/2005	S20970	6025 OLDE HARWICK CIR		865	GREASE	MANHOLE
OKC - DEER CREEK	3/23/2005	S20970	6201 KINGSBRIDGE DR.		865	GREASE	MANHOLE
OKC - DEER CREEK	4/4/2005	S20970	11109 ST. CHARLES AVE		300	GREASE, ROOTS & RAGS	MANHOLE
OKC - DEER CREEK	5/7/2005	S20970	N.W. 220TH & PENN		350	BLOCKAGE	MANHOLE
OKC - DEER CREEK	5/12/2005	S20970	8304 N.W. 117		800	BLOCKAGE	MANHOLE
OKC - DEER CREEK	6/3/2005	S20970	2837 INDIAN CREEK BLVD		200	BLOCKAGE	MANHOLE
OKC - DEER CREEK	7/14/2005	S20970	PLANT		50	MALFUNCTION	CLARIFIER
OKC - DEER CREEK	7/22/2005	S20970	ON GAILLARDIA PROPERTY		250	CONSTRUCTION BROKE THE LINE	PIPE
OKC - DEER CREEK	8/11/2005	S20970	PLANT PARKING LOT		50	SLUDGE RAN OUT OF TRUCK	
OKC - DEER CREEK	11/30/2005	S20970	3501 QUAIL CREEK RD.		130	BLOCKAGE	MANHOLE
OKC - DEER CREEK	12/18/2005	S20970	9812 PHEASANT LN.		400	GREASE & RAGS	MANHOLE
OKC - DEER CREEK	12/27/2005	S20970	7538 LYREWOOD LN.		100	BLOCKAGE	MANHOLE
OKC - DEER CREEK	3/24/2006	S20970	WILLOW CREEK BLVD. & BROOKSHIRE CIR.		25	BLOCKAGE	MANHOLE
OKC - DEER CREEK	4/6/2006	S20970	8029 WILLOW CREEK BLVD.		120	BLOCKAGE	MANHOLE

Facility Name	Date	Facility ID	Location	< or >	Amount (Gal)	Cause	Type Of Source
OKC - DEER CREEK	5/13/2006	S20970	12024 HOLLYROCK DR.		5	BLOCKAGE	MANHOLE
OKC - DEER CREEK	5/16/2006	S20970	PLANT		50	CONTRACTOR HIT LINE	
OKC - DEER CREEK	8/10/2006	S20970	15605 ALLEGHENY DR.		300	BLOCKAGE	MANHOLE
OKC - DEER CREEK	12/6/2006	S20970	2109 N.W. 118TH TERR		75	BLOCKAGE	MANHOLE
OKC - DEER CREEK	12/11/2006	S20970	PLANT		30	CRACK IN WALL	LAGOON/BASIN
OKC - DEER CREEK	12/17/2006	S20970	3316 EASTMAN DR.		550	BLOCKAGE	MANHOLE
OKC - DEER CREEK	12/21/2006	S20970	6017 KINGSBRIDGE DR.		80	BLOCKAGE	MANHOLE
OKC - DEER CREEK	12/22/2006	S20970	7700 LYREWOOD LN.		20	BLOCKAGE	MANHOLE
OKC - DEER CREEK	12/28/2006	S20970	N.W. 122ND & N. MERIDIAN		20	BLOCKAGE	MANHOLE
OKC - DEER CREEK	1/29/2007	S20970	PLANT			LEAK	
OKC - DEER CREEK	2/18/2007	S20970	2827 N.W. 112TH		75	BLOCKAGE	MANHOLE
OKC - DEER CREEK	3/3/2007	S20970	5200 N.W. 108TH TERR		40	BLOCKAGE	MANHOLE
OKC - DEER CREEK	3/13/2007	S20970	11732 BLUE MOON AVE.		50	GREASE	MANHOLE
OKC - DEER CREEK	3/20/2007	S20970	1505 N.W. 104TH		1,150	BLOCKAGE	MANHOLE
OKC - DEER CREEK	3/20/2007	S20970	11112 N.W. 116TH		250	BLOCKAGE	MANHOLE
OKC - DEER CREEK	3/31/2007	S20970	10201 LONG MEADOW RD.		150	BLOCKAGE	MANHOLE
OKC - DEER CREEK	3/31/2007	S20970	11112 N.W. 116TH		75	BLOCKAGE	MANHOLE
OKC - DEER CREEK	3/31/2007	S20970	SR. ANDREWS DR. & WINGFOOT DR.		1,360	BLOCKAGE	MANHOLE
OKC - DEER CREEK	3/31/2007	S20970	2932 N.W. 122ND		50	BLOCKAGE	MANHOLE
OKC - DEER CREEK	4/1/2007	S20970	10005 SENATE DR.		63	BLOCKAGE	MANHOLE
OKC - DEER CREEK	4/1/2007	S20970	5515 W. WILSHIRE BLVD.		355	BLOCKAGE	MANHOLE
OKC - DEER CREEK	4/7/2007	S20970	2816 N.W. 115TH PL.		500	BLOCKAGE	MANHOLE

Facility Name	Date	Facility ID	Location	< or >	Amount (Gal)	Cause	Type Of Source
OKC - DEER CREEK	4/7/2007	S20970	11601 N. MILLER AVE.		100	BLOCKAGE	MANHOLE
OKC - DEER CREEK	4/29/2007	S20970	MAC ARTHUR & GAELIC DR.		310	BLOCKAGE	MANHOLE
OKC - DEER CREEK	5/3/2007	S20970	13121 COBBLESTONE PKWY		1,000	BLOCKAGE	MANHOLE
OKC - DEER CREEK	5/5/2007	S20970	10408 CRICKET CANYON RD.		97	BLOCKAGE	MANHOLE
OKC - DEER CREEK	5/8/2007	S20970	PLANT		100	MALFUNCTION	
OKC - DEER CREEK	5/28/2007	S20970	3000 BROOKHOLLOW RD.		60	GREASE & ROOTS	MANHOLE
OKC - DEER CREEK	5/28/2007	S20970	11607 RUSHMORE		15	BLOCKAGE	MANHOLE
OKC - DEER CREEK	6/17/2007	S20970	7710 LYREWOOD LN.		770	GREASE, ROOTS & SLUDGE	MANHOLE
OKC - DEER CREEK	6/17/2007	S20970	8216 N.W. EXPRESSWAY		8,430	ROCKS & DEBRIS	MANHOLE
OKC - DEER CREEK	7/5/2007	S20970	5502 W. WILSHIRE		1,000	BLOCKAGE	MANHOLE
OKC - DEER CREEK	7/24/2007	S20970	8041 WILLOW CREEK BLVD.		880	BLOCKAGE	MANHOLE
OKC - DEER CREEK	9/7/2007	S20970	PLANT E. OF RBC BLDG.		60,000	CONTRACTOR ERROR	
OKC - DEER CREEK	9/17/2007	S20970	8145 N.W. EXPRESSWAY		90	BLOCKAGE	MANHOLE
OKC - DEER CREEK	9/27/2007	S20970	4491 S. LAKE HEFNER DR.		10	BLOCKAGE	MANHOLE
OKC - DEER CREEK	10/21/2007	S20970	10213 N. MCKINLEY		50	BLOCKAGE	MANHOLE
OKC - DEER CREEK	10/21/2007	S20970	8516 N.W. 92ND		25	BLOCKAGE	MANHOLE
OKC - DEER CREEK	10/24/2007	S20970	6413 GAELIC GLEN DR.		300	BLOCKAGE	MANHOLE
OKC - DEER CREEK	10/25/2007	S20970	13504 GREEN VALLEY DR.		60	BLOCKAGE	MANHOLE
OKC - DEER CREEK	10/27/2007	S20970	6301 S. COUNTRY CLUB DR.		450	BLOCKAGE	MANHOLE
OKC - DEER CREEK	10/30/2007	S20970	3901 N.W. 70TH		200	BLOCKAGE	MANHOLE
OKC - DEER CREEK	11/4/2007	S20970	5515 W. WILSHIRE		400	BLOCKAGE	MANHOLE
OKC - DEER CREEK	11/23/2007	S20970	4708 N.W. 75		178	BLOCKAGE	MANHOLE

Facility Name	Date	Facility ID	Location	< or >	Amount (Gal)	Cause	Type Of Source
OKC - DEER CREEK	11/24/2007	S20970	WILSHIRE & LAKE HEFNER RD.		200	BLOCKAGE	MANHOLE
OKC - DEER CREEK	12/6/2007	S20970	4239 N.W. EXPRESSWAY		75	BLOCKAGE	MANHOLE
OKC - DEER CREEK	12/18/2007	S20970	W. WILSHIRE BLVD. & W. LAKE HEFNER DR.		500	BLOCKAGE	MANHOLE
OKC - DEER CREEK	12/26/2007	S20970	PLANT		70	FIRE HYDRANT HIT	CLARIFIER
OKC - DEER CREEK	1/4/2008	S20970	7508 LYREWOOD LN.		100	BLOCKAGE	MANHOLE
OKC - DEER CREEK	1/9/2008	S20970	8300 N.W. 102ND		100	BLOCKAGE	MANHOLE
OKC - DEER CREEK	1/10/2008	S20970	7301 CROWN POINT RD.		100	BLOCKAGE	MANHOLE
OKC - DEER CREEK	1/10/2008	S20970	RED BUD ENERGY FACILITY - 20922 N. TRIPLE X RD.		2,000	AIR RELIEF VALVE STUCK	
OKC - DEER CREEK	1/18/2008	S20970	7513 KATHRYN WAY		1,000	BLOCKAGE	MANHOLE
OKC - DEER CREEK	1/21/2008	S20970	7538 LYREWOOD LN.		110	BLOCKAGE	MANHOLE
OKC - DEER CREEK	1/27/2008	S20970	3700 DOW DR.		1,310	BLOCKAGE	MANHOLE
OKC - DEER CREEK	1/28/2008	S20970	8033 WILLOW CREEK BLVD.		150	BLOCKAGE	MANHOLE
OKC - DEER CREEK	1/28/2008	S20970	PLANT		3,000	MALFUNCTION	
OKC - DEER CREEK	2/10/2008	S20970	4413 ST. THOMAS DR.		420	BLOCKAGE	MANHOLE
OKC - DEER CREEK	2/15/2008	S20970	7640 N.W. EXPRESSWAY		75	BLOCKAGE	MANHOLE
OKC - DEER CREEK	2/23/2008	S20970	13012 BURLINGAME AVE.		75	BLOCKAGE	MANHOLE
OKC - DEER CREEK	2/24/2008	S20970	4808 N.W. 77TH		1,020	BLOCKAGE	MANHOLE
OKC - DEER CREEK	2/27/2008	S20970	7212 LAKEWOOD CIR.		400	BLOCKAGE	MANHOLE
OKC - DEER CREEK	3/10/2008	S20970	7538 LYREWOOD LN.		35	BLOCKAGE	MANHOLE
OKC - DEER CREEK	3/23/2008	S20970	5822 HEFNER VILLAGE CIR.		1,360	BLOCKAGE	MANHOLE
OKC - DEER CREEK	3/26/2008	S20970	7800 N.W. EXPRESSWAY		300	BLOCKAGE	MANHOLE
OKC - DEER CREEK	4/3/2008	S20970	7538 LYREWOOD LN.		360	BLOCKAGE	MANHOLE

Facility Name	Date	Facility ID	Location	< or >	Amount (Gal)	Cause	Type Of Source
OKC - DEER CREEK	4/7/2008	S20970	9917 SKYLARK DR		35	BLOCKAGE	MANHOLE
OKC - DEER CREEK	4/8/2008	S20970	13213 PINEHURST RD.		150	BLOCKAGE	MANHOLE
OKC - DEER CREEK	4/10/2008	S20970	7317 N.W. 114TH TERR		150	BLOCKAGE	MANHOLE
OKC - DEER CREEK	4/17/2008	S20970	N.W. 122ND & MERIDIAN		100	BLOCKAGE	MANHOLE
OKC - DEER CREEK	4/18/2008	S20970	6924 TALBOT CT.		30	BLOCKAGE	MANHOLE
OKC - DEER CREEK	4/26/2008	S20970	6413 GAELIC GLEN DR.		1,000	BLOCKAGE	MANHOLE
OKC - DEER CREEK	5/11/2008	S20970	12200 CYPRESS LN		3,840	BLOCKAGE	MANHOLE
OKC - DEER CREEK	5/18/2008	S20970	2708 PEMBROKE TER.		900	BLOCKAGE	MANHOLE
OKC - DEER CREEK	5/24/2008	S20970	11130 QUAIL CREEK RD.		4,575	MAIN COLLAPSED	MANHOLE
OKC - DEER CREEK	5/25/2008	S20970	7800 N.W. EXPRESSWAY		740	BLOCKAGE	MANHOLE
OKC - DEER CREEK	6/10/2008	S20970	WWTP		1,500	BLOCKAGE	MANHOLE
OKC - DEER CREEK	6/24/2008	S20970	11600 ROCKY WAY		500	BLOCKAGE	MANHOLE
OKC - DEER CREEK	7/5/2008	S20970	7513 KATHRYN WAY		2,150	BLOCKAGE	MANHOLE
OKC - DEER CREEK	7/9/2008	S20970	DEER CREEK NORTH EAST FIELD		6,000	BROKEN LINE	
OKC - DEER CREEK	7/23/2008	S20970	PLANT		150	TESTING	
OKC - DEER CREEK	8/21/2008	S20970	MEMORIAL & INDIAN MERIDIAN VALVE STATION		1,000	BALL VALVE TO STATION BROKE	
OKC - DEER CREEK	8/22/2008	S20970	8001 N.W. 23RD		200	BLOCKAGE	MANHOLE
OKC - DEER CREEK	9/15/2008	S20970	PLANT		200	OVERFLOW	
OKC - DEER CREEK	9/23/2008	S20970	PLANT		2,100	OVERFLOW	
OKC - DEER CREEK	10/12/2008	S20970	8333 N.W. 107TH		120	BLOCKAGE	
OKC - DEER CREEK	10/24/2008	S20970	11145 COLECHESTER CT.		275	BLOCKAGE	MANHOLE
OKC - DEER CREEK	11/7/2008	S20970	2736 TEALWOOD DR.		6,500	BLOCKAGE	MANHOLE

Facility Name	Date	Facility ID	Location	< or >	Amount (Gal)	Cause	Type Of Source
OKC - DEER CREEK	11/13/2008	S20970	WWTP		10	LINE BREAK	
OKC - DEER CREEK	12/10/2008	S20970	PLANT		200	BROKEN LINE	
OKC - DEER CREEK	12/11/2008	S20970	N. MAY & INDIAN CREEK BLVD.		498	BLOCKAGE	MANHOLE
OKC - DEER CREEK	12/15/2008	S20970	PLANT		50	SPILL	SLUDGE HOLDING TANKS
OKC - DEER CREEK	12/18/2008	S20970	2600 TEALWOOD DR.		675	BLOCKAGE	MANHOLE
OKC - DEER CREEK	1/13/2009	S20970	9616 PHEASANT LN.		23	BLOCKAGE	MANHOLE
OKC - DEER CREEK	1/15/2009	S20970	N.E. CORNER OF STRUCTURE #37 (CHLORINE BLDG.)		150	LINE FROZE & BUSTED	PIPE
OKC - DEER CREEK	1/19/2009	S20970	6708 W. WILSHIRE BLVD.		75	BLOCKAGE	MANHOLE
OKC - DEER CREEK	1/23/2009	S20970	7000 W. BRITTON RD.		1,150	BLOCKAGE	MANHOLE
OKC - DEER CREEK	1/24/2009	S20970	6721 N.W. 135TH		500	BLOCKAGE	MANHOLE
OKC - DEER CREEK	1/27/2009	S20970	9749 MELTON CT.		5	BLOCKAGE	MANHOLE
OKC - DEER CREEK	2/25/2009	S20970	8701 N.W. 90TH		12	BLOCKAGE	MANHOLE
OKC - DEER CREEK	3/1/2009	S20970	1424 N.W. 104TH		284	BLOCKAGE	MANHOLE
OKC - DEER CREEK	3/9/2009	S20970	12426 TRAIL OAKS DR.		5	BLOCKAGE	MANHOLE
OKC - DEER CREEK	3/14/2009	S20970	10009 ROCKWELL TERR.		200	BLOCKAGE	MANHOLE
OKC - DEER CREEK	3/25/2009	S20970	WWTP		500	RUN OFF FROM HOSE	
OKC - DEER CREEK	3/30/2009	S20970	11916 MAPLE HOLLOW CT.		15	BLOCKAGE	MANHOLE
OKC - DEER CREEK	5/5/2009	S20970	10908 N. MAY		75	BLOCKAGE	MANHOLE
OKC - DEER CREEK	6/4/2009	S20970	3501 QUAIL CREEK RD.		75	BLOCKAGE	MANHOLE
OKC - DEER CREEK	6/14/2009	S20970	13608 INVERNESS AVE.		450	BLOCKAGE	MANHOLE
PIEDMONT	2/4/1997	S20996	164 & PIEDMONT RD. N.E.		1	PUMP FAILURE	
PIEDMONT	2/18/1997	S20996	EAST L.S.		1		
PIEDMONT	2/19/1997	S20996	E. SEWER L.S.;305 WASHINGTON S.E.		500	PUMP MALFUNCTION	

Facility Name	Date	Facility ID	Location	< or >	Amount (Gal)	Cause	Type Of Source
PIEDMONT	2/20/1997	S20996	EAST L.S.		30	PUMP FAILURE	
PIEDMONT	5/2/1997	S20996	EAST L.S., 700 BLK. WASHINGTON N.W.		750	MOTOR FAILURE	
PIEDMONT	9/29/1997	S20996	219 WASHINGTON N.E.		26,250	EQUIPMENT FAILURE	
PIEDMONT	9/30/1997	S20996	EAST L.S.		26,250	EQUIPMENT FAILURE ON PUMPS	
PIEDMONT	9/10/1998	S20996	WEST L.S. 301 BLK. WASHING		2,000	PUMP MALFUNCTION	
PIEDMONT	11/1/1998	S20996	409 & 410 TAYLOR AVE.		168	LINE STOPPAGE	
PIEDMONT	11/2/1998	S20996	301 WASHINGTON AVE. N.E.		65,000	PUMP FAILURE	
PIEDMONT	6/25/2002	S20996	3/4 MILE WEST OF PIEDMONT RD. ON 164TH		400	AIR VACUUM RELEASE BUSTED	
PIEDMONT	11/14/2002	S20996	164TH (WASHINGTON) & 7TH		10,000	BUSTED PIPE	PIPE
PIEDMONT	8/1/2003	S20996	164TH W. OF PIEDMONT RD. 3/8 OF MILE		2,000	MAIN BREAK FROM HEAT	PIPE
PIEDMONT	6/22/2004	S20996	W. OF PIEDMONT RD ON N. SIDE 1641 WASHINGTON		6,000	FLOODING	LIFT STATION
PIEDMONT	1/6/2005	S20996	W. OF PIEDMONT RD. N. SIDE OF 164TH & WASHINGTON		10,000	POWER FAILURE	MANHOLE
PIEDMONT	1/20/2005	S20996	1/4 E. OF PIEDMONT ON 164TH & WASHINGTON		25,000	BUSTED FORCE MAIN	PIPE
PIEDMONT	8/23/2005	S20996	120 EDMOND RD.		100	L.S. DOWN	MANHOLE

APPENDIX C
ESTIMATED FLOW EXCEEDANCE PERCENTILES

Appendix C

Estimated Flow Exceedance Percentiles

WQ Station	OK620910010010-001AT	OK620910-02-0040C	OK620910-02-0250C	OK620910-02-0270G	OK620910-02-0310C	OK620910030010-001AT OK620910-03-0010F OK620910-03-0010S	OK620910-04-0010G	OK620910-04-0100G	OK620910-04-0120B	OK620910-05-0010G OK620910-05-0010J	OK620910-05-0020G	OK620910-05-0030C	OK620910-05-0080D
	Cimarron River	**Cooper Creek**	**Deep Creek**	**Elm Creek**	**Indian Creek**	**Skeleton Creek**	**Cottonwood Creek**	**Chisholm Creek**	**Deer Creek**	**Kingfisher Creek**	**Trail Creek**	**Uncle Johns Creek**	**Dead Indian Creek**
WBID Segment	**OK620910010010_00**	**OK620910020040_00**	**OK620910020250_00**	**OK620910020270_00**	**OK620910020310_00**	**OK620910030010_00**	**OK620910040010_20**	**OK620910040100_00**	**OK620910040120_00**	**OK620910050010_00**	**OK620910050020_00**	**OK620910050030_00**	**OK620910050080_00**
USGS Gage Reference	07160000	07158400	07158400	07158400	07158400	07160500	07159720	07159750	07159720	07159200 07259000	07159200 07259000	07159200 07259000	07159200 07259000
Watershed Area (sq. mile)	28.9	118.4	86.0	25.6	74.1	335.6	94.0	50.1	113.2	229.9	18.2	155.0	115.4
NRCS Curve Number	68.1	75.2	74.1	80.5	68.7	73.2	77.4	75.7	74.4	74.0	81.3	74.5	74.2
Average Annual Rainfall (inch)	35.6	32.1	30.3	30.8	34.1	34.6	34.8	35.6	35.0	32.3	33.7	34.1	33.1
Percentile	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**	**Q (cfs)**
0.01	112,000.0	3,347.5	2429.97	723.59	2,094.2	39,200.0	7,570.1	4,584.5	9,123.4	6,480.0	751.18	6398.28	4766.31
0.135	41,234.6	2,298.7	1669.06	496.83	1,437.9	9,777.8	3,319.5	1,579.7	4,000.5	1,749.3	202.16	1721.94	1282.74
0.27	36,235.1	1,496.2	1087.06	323.27	935.6	6,891.3	2,512.0	1,124.8	3,026.7	1,371.4	158.63	1351.14	1006.52
1	19,809.0	634.4	460.55	137.14	396.9	3,710.2	1,045.2	430.8	1,259.4	640.0	73.89	629.36	468.83
5	5,994.5	102.1	74.13	22.07	63.9	758.0	268.4	124.3	323.2	133.5	15.65	130.02	96.85
10	3,100.0	29.0	21.05	6.40	18.1	267.0	140.1	65.9	169.6	45.1	5.22	44.43	33.10
15	2,040.0	17.5	12.72	3.79	11.0	142.0	77.8	40.8	94.2	18.6	2.09	17.77	13.24
20	1,440.0	12.1	8.77	2.61	7.6	90.0	51.1	28.3	61.9	9.9	1.16	9.58	7.13
25	1,090.0	9.7	7.02	2.09	6.0	62.8	37.9	22.2	46.3	6.1	0.73	6.02	4.49
30	877.0	7.9	5.70	1.70	4.9	45.0	30.4	17.4	36.7	4.3	0.51	4.25	3.17
35	704.2	6.6	4.82	1.44	4.2	35.0	25.1	13.8	30.3	3.2	0.39	3.16	2.33
40	586.0	6.0	4.39	1.31	3.8	28.0	20.9	11.6	25.7	2.3	0.28	2.27	1.69
45	480.0	5.4	3.95	1.18	3.5	22.0	19.0	9.9	23.4	1.8	0.21	1.78	1.32
50	400.0	4.8	3.51	1.04	3.0	18.0	17.5	8.6	21.1	1.4	0.16	1.38	1.02
55	328.0	4.2	3.07	0.91	2.6	15.0	16.0	7.7	19.3	0.9	0.11	0.88	0.65
60	273.0	3.6	2.59	0.77	2.3	12.0	14.1	6.7	17.0	0.6	0.08	0.63	0.47
65	224.0	3.2	2.32	0.69	2.0	10.0	12.2	6.0	15.1	0.4	0.05	0.44	0.33
70	184.0	2.8	2.05	0.60	1.8	8.6	11.0	5.3	13.3	0.3	0.04	0.31	0.23
75	145.0	2.5	1.80	0.54	1.6	7.0	9.5	4.7	11.5	0.2	0.02	0.19	0.14
80	112.0	2.0	1.49	0.44	1.3	5.9	8.0	4.1	9.6	0.1	0.01	0.13	0.09
85	87.0	1.7	1.23	0.37	1.1	4.7	7.2	3.4	8.7	0.1	0.01	0.06	0.05
90	57.0	1.3	0.96	0.29	0.8	3.6	6.5	2.8	7.8	0.0	0.00	0.03	0.02
95	26.0	0.7	0.53	0.16	0.5	2.1	5.3	2.3	6.9	0.0	0.00	0.00	0.00
99	3.9	0.2	0.18	0.05	0.2	0.3	4.2	1.5	5.5	0.0	0.00	0.00	0.00
99.865	0.9	0.1	0.06	0.01	0.05	0.0	1.7	1.0	4.1	0.0	0.00	0.00	0.00
100	0.50	3,347.5	0.04	0.00	0.03	0.00	0.00	0.95	3.90	0.00	0.00	0.00	0.00

Appendix C
General Methodology for Estimating Stream Flow

Flows duration curve will be developed using existing USGS measured flow where the data exist from a gage on the stream segment of interest, or by estimating flow for stream segments with no corresponding flow record. Flow data to support flow duration curves and load duration curves will be derived for each Oklahoma stream segment in the following priority:

i) In cases where a USGS flow gage occurs on, or within one-half mile upstream or downstream of the Oklahoma stream segment.

a. If simultaneously-collected flow data matching the water quality sample collection date are available, these flow measurements will be used.

b. If flow measurements at the coincident gage are missing for some dates on which water quality samples were collected, the gaps in the flow record will be filled, or the record will be extended, by estimating flow based on measured streamflows at a nearby gage. First, the most appropriate nearby stream gage is identified. All flow data are first log-transformed to linearize the data because flow data are highly skewed. Linear regressions are then developed between 1) daily streamflow at the gage to be filled/extended, and 2) streamflow at all gages within 95 miles that have at least 300 daily flow measurements on matching dates. The station with the best flow relationship, as indicated by the highest r-squared value, is selected as the index gage. R-squared indicates the fraction of the variance in flow explained by the regression. The regression is then used to estimate flow at the gage to be filled/extended from flow at the index station. Flows will not be estimated based on regressions with r-squared values less than 0.25, even if that is the best regression. In some cases, it will be necessary to fill/extend flow records from two or more index gages. The flow record will be filled/extended to the extent possible based on the best index gage (highest r-squared value), and remaining gaps will be filled from the next best index gage (second highest r-squared value), and so forth.

c. Flow duration curves will be based on measured flows only, not on the filled or extended flow time series calculated from other gages using regression.

d. On a stream impounded by dams to form reservoirs of sufficient size to impact stream flow, only flows measured after the date of the most recent impoundment will be used to develop the flow duration curve. This also applies to reservoirs on major tributaries to the stream.

ii) In the case no coincident flow data are available for a stream segment, but flow gage(s) are present upstream and/or downstream without a major reservoir between, flows will be estimated for the stream segment from an upstream or downstream gage using a watershed area ratio method derived by delineating subwatersheds, and relying on the National Resources Conservation Service (NRCS) runoff curve numbers and antecedent rainfall condition. Drainage subbasins will first be delineated for all impaired 303(d)-listed stream segments, along with all USGS flow stations located in the 8-digit HUCs with impaired streams. Parsons will then identify all the USGS gage stations upstream and downstream of the subwatersheds with 303(d) listed stream segments.

a. Watershed delineations are performed using ESRI Arc Hydro with a 30 m resolution National Elevation Dataset (NED) digital elevation model, and National Hydrography Dataset (NHD) streams. The area of each watershed will be calculated following watershed delineation.

b. The watershed average curve number is calculated from soil properties and land cover as described in the U.S. Department of Agriculture (USDA) Publication *TR-55: Urban Hydrology for Small Watersheds*. The soil hydrologic group is extracted from NRCS STATSGO soil data, and land use category from the 2001 National Land Cover Dataset (NLCD). Based on land use and the hydrologic soil group, SCS curve numbers are estimated at the 30-meter resolution of the NLCD grid as shown in Table 7. The average curve number is then calculated from all the grid cells within the delineated watershed.

c. The average rainfall is calculated for each watershed from gridded average annual precipitation datasets for the period 1971-2000 (Spatial Climate Analysis Service, Oregon State University, http://www.ocs.oregonstate.edu/prism/, created 20 Feb 2004).

Table C-1 Runoff Curve Numbers for Various Land Use Categories and Hydrologic Soil Groups

NLCD Land Use Category	Curve number for hydrologic soil group			
	A	B	C	D
0 in case of zero	100	100	100	100
11 Open Water	100	100	100	100
12 Perennial Ice/Snow	100	100	100	100
21 Developed, Open Space	39	61	74	80
22 Developed, Low Intensity	57	72	81	86
23 Developed, Medium Intensity	77	85	90	92
24 Developed, High Intensity	89	92	94	95
31 Barren Land (Rock/Sand/Clay)	77	86	91	94
32 Unconsolidated Shore	77	86	91	94
41 Deciduous Forest	37	48	57	63
42 Evergreen Forest	45	58	73	80
43 Mixed Forest	43	65	76	82
51 Dwarf Scrub	40	51	63	70
52 Shrub/Scrub	40	51	63	70
71 Grasslands/Herbaceous	40	51	63	70
72 Sedge/Herbaceous	40	51	63	70
73 Lichens	40	51	63	70
74 Moss	40	51	63	70
81 Pasture/Hay	35	56	70	77
82 Cultivated Crops	64	75	82	85
90-99 Wetlands	100	100	100	100

d. Flow at the ungaged site is calculated from the gaged site. The NRCS runoff curve number equation is:

$$Q = \frac{(P - I_a)^2}{(P - I_a) + S} \qquad (1)$$

where:

Q = runoff (inches)

P = rainfall (inches)

S = potential maximum retention after runoff begins (inches)

I_a = initial abstraction (inches)

If $P < 0.2S$, $Q = 0$. Initial abstraction has been found to be empirically related to S by the equation

$$I_a = 0.2*S \qquad (2)$$

Thus, the runoff curve number equation can be rewritten:

$$Q = \frac{(P - 0.2S)^2}{P + 0.8S} \qquad (3)$$

S is related to the curve number (CN) by:

$$S = \frac{1000}{CN} - 10 \qquad (4)$$

e. First, S is calculated from the average curve number for the gaged watershed. Next, the daily historic flows at the gage are converted to depth basis (as used in equations 1 and 3) by dividing by its drainage area, then converted to inches. Equation 3 is then solved for daily precipitation depth of the gaged site, P_{gaged}. The daily precipitation depth for the ungaged site is then calculated as the precipitation depth of the gaged site multiplied by the ratio of the long-term average precipitation in the watersheds of the ungaged and gaged sites:

$$P_{ungaged} = P_{gaged}\left(\frac{M_{ungaged}}{M_{gaged}}\right) \qquad (5)$$

where M is the mean annual precipitation of the watershed in inches. The daily precipitation depth for the ungaged watershed, along with the average curve number of the ungaged watershed, are then used to calculate the depth equivalent daily flow Q of the ungaged site. Finally, the volumetric flow rate at the ungaged site is calculated by multiplying by the area of the watershed of the ungaged site and converted to cubic ft..

f. If any flow measurements are available on the stream segment of interest, the projected flows will be compared to the measured flows on each date. If there is poor agreement, projections will be repeated with a simpler approach, using only the watershed area ratio and the gaged site (thereby eliminating the influence of differences in curve number and precipitation between the gaged and ungaged stream watersheds). If this simpler approach provides better agreement with existing data, the projected flows based on the simpler approach will be used.

iii) In the rare case where no coincident flow data are available for a stream segment and no gages are present upstream or downstream, flows will be estimated for the stream segment from a gage on an adjacent watershed of similar size and properties, via the same procedure described above for upstream or downstream gages.

APPENDIX D
STATE OF OKLAHOMA ANTIDEGRADATION POLICY

Appendix D
State of Oklahoma Antidegradation Policy

785:45-3-1. Purpose; Antidegradation policy statement

(a) Waters of the state constitute a valuable resource and shall be protected, maintained and improved for the benefit of all the citizens.

(b) It is the policy of the State of Oklahoma to protect all waters of the state from degradation of water quality, as provided in OAC 785:45-3-2 and Subchapter 13 of OAC 785:46.

785:45-3-2. Applications of antidegradation policy

(a) Application to outstanding resource waters (ORW). Certain waters of the state constitute an outstanding resource or have exceptional recreational and/or ecological significance. These waters include streams designated "Scenic River" or "ORW" in Appendix A of this Chapter, and waters of the State located within watersheds of Scenic Rivers. Additionally, these may include waters located within National and State parks, forests, wilderness areas, wildlife management areas, and wildlife refuges, and waters which contain species listed pursuant to the federal Endangered Species Act as described in 785:45-5-25(c)(2)(A) and 785:46-13-6(c). No degradation of water quality shall be allowed in these waters.

(b) Application to high quality waters (HQW). It is recognized that certain waters of the state possess existing water quality which exceeds those levels necessary to support propagation of fishes, shellfishes, wildlife, and recreation in and on the water. These high quality waters shall be maintained and protected.

(c) Application to beneficial uses. No water quality degradation which will interfere with the attainment or maintenance of an existing or designated beneficial use shall be allowed.

(d) Application to improved waters. As the quality of any waters of the state improve, no degradation of such improved waters shall be allowed.

785:46-13-1. Applicability and scope

(a) The rules in this Subchapter provide a framework for implementing the antidegradation policy stated in OAC 785:45-3-2 for all waters of the state. This policy and framework includes three tiers, or levels, of protection.

(b) The three tiers of protection are as follows:

  (1) Tier 1. Attainment or maintenance of an existing or designated beneficial use.

  (2) Tier 2. Maintenance or protection of High Quality Waters and Sensitive Public and Private Water Supply waters.

  (3) Tier 3. No degradation of water quality allowed in Outstanding Resource Waters.

(c) In addition to the three tiers of protection, this Subchapter provides rules to implement the protection of waters in areas listed in Appendix B of OAC 785:45. Although Appendix B areas are not mentioned in OAC 785:45-3-2, the framework for protection of Appendix B areas is similar to the implementation framework for the antidegradation policy.

(d) In circumstances where more than one beneficial use limitation exists for a waterbody, the most protective limitation shall apply. For example, all antidegradation policy implementation rules applicable to Tier 1 waterbodies shall be applicable also to Tier 2 and Tier 3 waterbodies or areas, and implementation rules applicable to Tier 2 waterbodies shall be applicable also to Tier 3 waterbodies.

(e) Publicly owned treatment works may use design flow, mass loadings or concentration, as appropriate, to calculate compliance with the increased loading requirements of this section if those flows, loadings or concentrations were approved by the Oklahoma Department of Environmental Quality as a portion of Oklahoma's Water Quality Management Plan prior to the application of the ORW, HQW or SWS limitation.

785:46-13-2. Definitions

The following words and terms, when used in this Subchapter, shall have the following meaning, unless the context clearly indicates otherwise:

"Specified pollutants" means

(A) Oxygen demanding substances, measured as Carbonaceous Biochemical Oxygen Demand (CBOD) and/or Biochemical Oxygen Demand (BOD);

(B) Ammonia Nitrogen and/or Total Organic Nitrogen;

(C) Phosphorus;

(D) Total Suspended Solids (TSS); and

(E) Such other substances as may be determined by the Oklahoma Water Resources Board or the permitting authority.

785:46-13-3. Tier 1 protection; attainment or maintenance of an existing or designated beneficial use

(a) General.

(1) Beneficial uses which are existing or designated shall be maintained and protected.

(2) The process of issuing permits for discharges to waters of the state is one of several means employed by governmental agencies and affected persons which are designed to attain or maintain beneficial uses which have been designated for those waters. For example, Subchapters 3, 5, 7, 9 and 11 of this Chapter are rules for the permitting process. As such, the latter Subchapters not only implement numerical and narrative criteria, but also implement Tier 1 of the antidegradation policy.

(b) Thermal pollution. Thermal pollution shall be prohibited in all waters of the state. Temperatures greater than 52 degrees Centigrade shall constitute thermal pollution and shall be prohibited in all waters of the state.

(c) Prohibition against degradation of improved waters. As the quality of any waters of the state improves, no degradation of such improved waters shall be allowed.

785:46-13-4. Tier 2 protection; maintenance and protection of High Quality Waters and Sensitive Water Supplies

(a) General rules for High Quality Waters. New point source discharges of any pollutant after June 11, 1989, and increased load or concentration of any specified pollutant from any point source discharge existing as of June 11, 1989, shall be prohibited in any waterbody or watershed designated in Appendix A of OAC 785:45 with the limitation "HQW". Any discharge of any pollutant to a waterbody designated "HQW" which would, if it occurred, lower existing water quality shall be prohibited. Provided however, new point source discharges or increased load or concentration of any specified pollutant from a discharge existing as of June 11, 1989, may be approved by the permitting authority in circumstances where the discharger demonstrates to the satisfaction of the permitting authority that such new discharge or increased load or concentration would result in maintaining or improving the level of water quality which exceeds that necessary to support recreation and propagation of fishes, shellfishes, and wildlife in the receiving water.

(b) General rules for Sensitive Public and Private Water Supplies. New point source discharges of any pollutant after June 11, 1989, and increased load of any specified pollutant from any point source discharge existing as of June 11, 1989, shall be prohibited in any waterbody or watershed designated in Appendix A of OAC 785:45 with the limitation "SWS". Any discharge of any pollutant to a waterbody designated "SWS" which would, if it occurred, lower existing water quality shall be prohibited. Provided however, new point source discharges or increased load of any specified pollutant from a discharge existing as of June 11, 1989, may be approved by the permitting authority in circumstances where the discharger demonstrates to the satisfaction of the permitting authority that such new discharge or increased load will result in maintaining or improving the water quality in both the direct receiving water, if designated SWS, and any downstream waterbodies designated SWS.

(c) Stormwater discharges. Regardless of subsections (a) and (b) of this Section, point source discharges of stormwater to waterbodies and watersheds designated "HQW" and "SWS" may be approved by the permitting authority.

(d) Nonpoint source discharges or runoff. Best management practices for control of nonpoint source discharges or runoff should be implemented in watersheds of waterbodies designated "HQW" or "SWS" in Appendix A of OAC 785:45.

785:46-13-5. Tier 3 protection; prohibition against degradation of water quality in outstanding resource waters

(a) General. New point source discharges of any pollutant after June 11, 1989, and increased load of any pollutant from any point source discharge existing as of June 11, 1989, shall be prohibited in any waterbody or watershed designated in Appendix A of OAC 785:45 with the limitation "ORW" and/or "Scenic River", and in any waterbody located within the watershed of any waterbody designated with the limitation "Scenic River". Any discharge of any pollutant to a waterbody designated "ORW" or "Scenic River" which would, if it occurred, lower existing water quality shall be prohibited.

(b) Stormwater discharges. Regardless of 785:46-13-5(a), point source discharges of stormwater from temporary construction activities to waterbodies and watersheds designated "ORW" and/or "Scenic River" may be permitted by the permitting authority. Regardless of 785:46-13-5(a), discharges of stormwater to waterbodies and watersheds designated "ORW" and/or "Scenic River" from point sources existing as of June 25, 1992, whether or not such stormwater discharges were permitted as point sources prior to June 25, 1992, may be permitted by the permitting authority; provided, however, increased load of any pollutant from such stormwater discharge shall be prohibited.

(c) Nonpoint source discharges or runoff. Best management practices for control of nonpoint source discharges or runoff should be implemented in watersheds of waterbodies designated "ORW" in Appendix A of OAC 785:45, provided, however, that development of conservation plans shall be required in sub-watersheds where discharges or runoff from nonpoint sources are identified as causing or significantly contributing to degradation in a waterbody designated "ORW".

(d) LMFO's. No licensed managed feeding operation (LMFO) established after June 10, 1998 which applies for a new or expanding license from the State Department of Agriculture after March 9, 1998 shall be located...[w]ithin three (3) miles of any designated scenic river area as specified by the Scenic Rivers Act in 82 O.S. Section 1451 and following, or [w]ithin one (1) mile of a waterbody [2:9-210.3(D)] designated in Appendix A of OAC 785:45 as "ORW".

785:46-13-6. Protection for Appendix B areas

(a) General. Appendix B of OAC 785:45 identifies areas in Oklahoma with waters of recreational and/or ecological significance. These areas are divided into Table 1, which includes national and state parks, national forests, wildlife areas, wildlife management areas and wildlife refuges; and Table 2, which includes areas which contain threatened or endangered species listed as such by the federal government pursuant to the federal Endangered Species Act as amended.

(b) Protection for Table 1 areas. New discharges of pollutants after June 11, 1989, or increased loading of pollutants from discharges existing as of June 11, 1989, to waters within the boundaries of areas listed in Table 1 of Appendix B of OAC 785:45 may be approved by the permitting authority under such conditions as ensure that the recreational and ecological significance of these waters will be maintained.

(c) Protection for Table 2 areas. Discharges or other activities associated with those waters within the boundaries listed in Table 2 of Appendix B of OAC 785:45 may be restricted through agreements between appropriate regulatory agencies and the United States Fish and Wildlife Service. Discharges or other activities in such areas shall not substantially disrupt the threatened or endangered species inhabiting the receiving water.

(d) Nonpoint source discharges or runoff. Best management practices for control of nonpoint source discharges or runoff should be implemented in watersheds located within areas listed in Appendix B of OAC 785:45.

APPENDIX E

STORM WATER PERMITTING REQUIREMENTS AND PRESUMPTIVE BEST MANAGEMENT PRACTICES (BMPS) APPROACH

APPENDIX E

STORM WATER PERMITTING REQUIREMENTS AND PRESUMPTIVE BEST MANAGEMENT PRACTICES (BMPS) APPROACH

A. BACKGROUND

The National Pollutant Discharge Elimination System (NPDES) permitting program for stormwater discharges was established under the Clean Water Act as the result of a 1987 amendment. The Act specifies the level of control to be incorporated into the NPDES stormwater permitting program depending on the source (industrial versus municipal stormwater). These programs contain specific requirements for the regulated communities/facilities to establish a comprehensive stormwater management program (SWMP) or storm water pollution prevention plan (SWPPP) to implement any requirements of the total maximum daily load (TMDL) allocation. [See 40 CFR §130.]

Storm water discharges are highly variable both in terms of flow and pollutant concentration, and the relationships between discharges and water quality can be complex. For municipal stormwater discharges in particular, the current use of system-wide permits and a variety of jurisdiction-wide BMPs, including educational and programmatic BMPs, does not easily lend itself to the existing methodologies for deriving numeric water quality-based effluent limitations. These methodologies were designed primarily for process wastewater discharges which occur at predictable rates with predictable pollutant loadings under low flow conditions in receiving waters.

EPA has recognized these problems and developed permitting guidance for stormwater permits. [See "Interim Permitting Approach for Water Quality-Based Effluent Limitations in Stormwater Permits" (EPA-833-D-96-00, Date published: 09/01/1996)] Due to the nature of storm water discharges, and the typical lack of information on which to base numeric water quality-based effluent limitations (expressed as concentration and mass), EPA recommends an interim permitting approach for NPDES storm water permits which is based on BMPs. "The interim permitting approach uses best management practices (BMPs) in first-round storm water permits, and expanded or better-tailored BMPs in subsequent permits, where necessary, to provide for the attainment of water quality standards." (*ibid.*)

A monitoring component is also included in the recommended BMP approach. "Each storm water permit should include a coordinated and cost-effective monitoring program to gather necessary information to determine the extent to which the permit provides for attainment of applicable water quality standards and to determine the appropriate conditions or limitations for subsequent permits." (*ibid.*)

This approach was further elaborated in a guidance memo issued in 2002. [See Memorandum from Robert Wayland, Director of OWOW and James Hanlon, Director of OWM to Regional Water Division Directors: "Establishing Total Maximum Daily Load (TMDL) Wasteload Allocations (WLAs) for Storm Water Sources and NPDES Permit requirements Based on Those WLAs " (Date published: 11/22/2002)] "The policy outlined in this memorandum affirms the appropriateness of an iterative, adaptive management BMP approach, whereby permits include effluent limits (e.g., a combination of structural and non-structural BMPs) that address storm water discharges, implement mechanisms to evaluate the performance of such controls, and make adjustments (i.e., more stringent controls or specific BMPs) as necessary to protect water quality. …… If it is determined that a BMP approach (including an iterative BMP approach) is appropriate to meet the storm water component of the TMDL, EPA recommends that the TMDL reflect this." This BMP-based approach to stormwater sources in TMDLs is also recognized and described in the most recent EPA guidance. [See "TMDLs To Stormwater Permits Handbook" (DRAFT), EPA, November 2008] This TMDL adopts the EPA recommended approach and relies on appropriate BMPs for implementation. No numeric effluent limitations are required or anticipated for municipal stormwater discharge permits.

B. SPECIFIC SWMP/SWPPP REQUIREMENTS

As noted in Section 3 of this report, Oklahoma Pollutant Discharge Elimination System (OPDES)-permitted facilities and non-point sources (e.g., wildlife, agricultural activities and domesticated animals, land application fields, urban runoff, failing onsite wastewater disposal system, and domestic pets) could contribute to exceedances of the water quality criteria. In particular, stormwater runoff from the Phase 1 and 2 municipal separate storm sewer systems (MS4s) is likely to contain elevated bacteria concentrations. Permits for these discharges must comply with the provisions of this TMDL. Table E-1 provides a list of Phase 1 and 2 MS4s that are affected by the TMDL for the Study Area.

Table E-1. MS4 Permits affected by this bacteria TMDL Report

ENTITIES	PHASE 1 / PHASE 2 MS4	DATE ISSUED
Oklahoma City[1]	Phase 1 MS4	01/19/2007

[1] Co-permittee with ODOT and OTA

Agricultural activities and other nonpoint sources of bacteria are unregulated. Voluntary measures and incentives should be used and encouraged wherever possible and such sources should strive to attain the reduction goals established in this TMDL.

The provisions of this appendix apply only to OPDES/NPDES regulated stormwater discharges. Regulated CAFOs within the watershed operate under NPDES permits issued and overseen by EPA. In order to comply with this TMDL, those CAFO permits in the watershed and their associated management plans must be reviewed. Further actions to reduce bacteria loads and achieve progress toward meeting the specified reduction goals must be implemented. This provision will be forwarded to EPA, as the responsible permitting agency, for follow up.

To ensure compliance with the TMDL requirements under the permit, stormwater permittees must develop strategies designed to achieve progress toward meeting the reduction goals established in the TMDL. Relying primarily upon a Best Management Practices (BMP) approach, permittees should take advantage of existing information on BMP performance and select a suite of BMPs appropriate to the local community that are expected to result in progress toward meeting the reduction goals established in the TMDL. The permittee should provide guidance on BMP installation and maintenance, as well as a monitoring and/or inspection schedule.

Table E–2 provides a summary description of some BMPs with reported effectiveness in reducing bacteria. Permittees may choose different BMPs to meet the permit requirements, as long as the permittees demonstrate that these practices will result in progress toward attaining water quality standards.

As noted above, when a BMP approach is selected a coordinated monitoring program is necessary to establish the effectiveness of the selected BMPs and demonstrate progress toward attaining water quality standards. The monitoring results should be used to refine bacteria controls in the future.

After EPA approval of the final TMDL, existing small MS4 permittees will be notified of the TMDL provisions and schedule. The "Phase 1" permit for the City of Oklahoma City expires on January 18, 2012. The re-issued permit will contain general provisions addressing this TMDL. Industrial stormwater permittees are not expected to be a significant source of bacteria but if any are identified, similar actions will be required. Compliance with the following provisions will constitute compliance with the requirements of this TMDL.

1. Develop a Bacteria Reduction Plan

Permittees shall submit an approvable Bacteria Reduction Plan to the DEQ within 12 months of notification. Unless disapproved by the Director within 60 days of submission, the plan shall be approved then implemented by the permittee. This plan shall, at a minimum, include the following:

a. Consideration of ordinances or other regulatory mechanisms to require bacteria pollution control, as well enforcement procedures for noncompliance;
b. Evaluation of the existing SWMP in relation to TMDL reduction goals;
c. An evaluation to identify potential significant sources of bacteria entering your MS4. Develop (or modify an existing program as necessary) and implement a program to reduce the discharge of bacteria in municipal storm water contributed by any other significant source identified in the source identification evaluation
d. Educational programs directed at reducing bacterial pollution. Implement a public education program to reduce the discharge of bacteria in municipal storm water contributed (if applicable) by pets, recreational and exhibition livestock, and zoos;
e. Investigation and implementation of BMPs that prevent additional storm water bacteria pollution associated with new development and re-development;
f. Develop (or modify an existing program as necessary) and implement a program to reduce the discharge of bacteria in municipal storm water contributed by areas within your MS4 served by on-site wastewater treatment systems
g. Implementation of BMPs applicable to bacteria. Table E-2 below presents summary information on some BMPs that should be considered. Permittees are not limited to BMPs on this list and should select BMPs appropriate to the local community that are expected to result in progress toward meeting the reduction goals established in the TMDL.
h. Modifications to the dry weather field screening and illicit discharge detection and elimination provisions of the SWMP to consider storm water sampling and other measures intended to specifically identify bacterial pollution sources and high priority areas for bacteria reductions.
i. Periodic evaluation of the effectiveness of the bacteria reduction plan to ensure progress toward attainment of water quality standards.

j. An implementation schedule leading to modification of the SWMP and full implementation of the plan within 3 years of notification.

2. Develop or Participate in a Bacteria Monitoring Program

Permittees may participate in a coordinated regional bacteria monitoring program or develop their own individual program. The monitoring program should be designed to establish the effectiveness of the selected BMPs and demonstrate progress toward achieving the reduction goals of the TMDL and eventual attainment of water quality standards.

a. Within 18 months of notification, the permittee shall prepare and submit to the DEQ either a TMDL monitoring plan or a commitment to participate in a coordinated regional monitoring program. Unless disapproved by the Director within 60 days of submission, the plan shall be approved then implemented by the permittee. The plan or program shall include:

    (1) A detailed description of the goals, monitoring, and sampling and analytical methods;

    (2) A list and map of the selected TMDL monitoring sites;

    (3) The frequency of data collection to occur at each station or site;

    (4) The parameters to be measured, as appropriate for and relevant to the TMDL;

    (5) A Quality Assurance Project Plan that complies with EPA requirements [EPA Requirements for QA Project Plans (QA/R-5)]

b. The monitoring program shall be fully implemented within 3 years of notification.

3. Annual Reporting

The permittee shall include a TMDL implementation report as part of their annual report. The TMDL implementation report shall include the status and actions taken by the permittee to implement the Bacteria Reduction Plan and monitoring program. The TMDL implementation report shall document relevant actions taken by the permittee that affect MS4 storm water discharges to the waterbody segment that is the subject of the TMDL. This TMDL implementation report also shall identify the status of any applicable TMDL implementation schedule milestones.

Table E-2. Some BMPs Applicable to Bacteria

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE		Reported EFFICIENCY	NOTE
	AGRICULTURE	URBAN		
Animal waste management: A planned system designed to manage liquid and solid waste from livestock and poultry. It improves water quality by storing and spreading waste at the proper time, rate and location.	X		75 %[1]	
Artificial wetland/rock reed microbial filter: A long shallow hydroponic plant/rock filter system that treats polluted waste and wastewater. It combines horizontal and vertical flow of water through the filter, which is filled with aquatic and semi-aquatic plants and microorganisms and provides a high surface area of support media, such as rocks or crushed stone.	X	X		
Compost facility: Treating organic agricultural wastes in order to reduce the pollution potential to surface and ground water. The composting facility must be constructed, operated and maintained without polluting air and/or water resources.	X	X		Permit may be needed
Conservation landscaping: The placement of vegetation in and around stormwater management BMPs. Its purpose is to help stabilize disturbed areas, enhance the pollutant removal capabilities of storm water BMP, and improve the overall aesthetics of a storm water BMP.		X		
Diversions: Establishing a channel with a supporting ridge on the lower side constructed along the general land slope which improves water quality by directing nutrient and sediment laden water to sites where it can be used or disposed of safely.	X	X		
Drain Inlet Inserts: A proprietary BMP that is generally easily installed in a drain inlet or catch basin to treat storm water runoff. Three basic types of inlet insert are available, the tray type, bag type and basket type. The tray type allows flow to pass through filter media residing in a tray located around the perimeter of the inlet.	X	X	5%[2]	
Dry detention pond/basin: Detention ponds/basins that have been designed to temporarily detain stormwater runoff. These ponds fill with stormwater and release it over a period of a few days. They can also be used to provide flood control by including additional flood detention storage.	X	X	40%[2], 51%[3] 88% [4]	
Earthen embankments: A raised impounding structure made from compacted soil. It is appropriate for use with infiltration, detention, extended-detention or retention	X	X		

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE		Reported EFFICIENCY	NOTE
	AGRICULTURE	URBAN		
facilities.				
Drip irrigation: An irrigation method that supplies a slow, even application of low-pressure water through polyethylene tubing running from supply line directly to a plant's base. Water soaks into the soil gradually, reducing runoff and evaporation (i.e., salinity). Transmission of nutrients and pathogens spread by splashing water and wet foliage created by overhead sprinkler irrigation is greatly reduced. Weed growth is minimized, thereby reducing herbicide applications. Vegetable farming and virtually every type of landscape situation can benefit from the use of drip irrigation.	X	X		
Fencing: A constructed barrier to livestock, wildlife or people. Standard or conventional (barbed or smooth wire), suspension, woven wire, or electric fences shall consist of acceptable fencing designs to control the animal(s) or people of concern and meet the intended life of the practice.	X		75 %[1]	
Filtration (e.g., sand filters): Intermittent sand filters capture, pre-treat to remove sediments, store while awaiting treatment, and treat to remove pollutants (by percolation through sand media) the most polluted stormwater from a site. Intermittent sand filter BMPs may be constructed in underground vaults, in paved trenches within or at the perimeter of impervious surfaces, or in either earthen or concrete open basins.	X	X	30 %[1], 55%[2], 37% [4]	
Infiltration Basin: A vegetated open impoundment where incoming stormwater runoff is stored until it gradually infiltrates into the soil strata. While flooding and channel erosion control may be achieved within an infiltration basin, they are primarily used for water quality enhancement.		X	50 %[1]	
Infiltration Trench: A shallow, excavated trench backfilled with a coarse stone aggregate to create an underground reservoir. Stormwater runoff diverted into the trench gradually infiltrates into the surrounding soils from the bottom and sides of the trench. The trench can be either an open surface trench or an underground facility.		X	50 %[1]	
Irrigation water management: The process of determining and controlling the volume, frequency, and application rate of irrigation water in a planned, efficient manner. An irrigation system adapted for site conditions (soil, slope, crop grown, climate, water quantity and quality, etc.) must be available and capable of applying water to meet the intended purpose(s).	X	X		

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE		Reported EFFICIENCY	NOTE
	AGRICULTURE	URBAN		
Lagoon pump out: A waste treatment impoundment made by constructing an embankment and/or excavating a pit or dugout in order to biologically treat waste (such as manure and wastewater) and thereby reduce pollution potential by serving as a treatment component of a waste management system.	X	X		
Land-use conversion: BMPs that involve a change in land use in order to retire land contributing detrimentally to the environment. Some examples of BMPs with associated land use changes are: Conservation Reserve Program (CRP) - cropland to pasture; Forest conservation - pervious urban to forest; Forest/grass buffers - cropland to forest/pasture; Tree planting - cropland/pasture to forest; and Conservation tillage – conventional tillage to conservation tillage.	X	X		
Limit livestock access: Excluding livestock from areas where grazing or trampling will cause erosion of stream banks and lowering of water quality by livestock activity in or adjacent to the water. Limitation is generally accomplished by permanent or temporary fencing. In addition, installation of an alternative water source away from the stream has been shown to reduce livestock access.	X			
Litter control: Litter includes larger items and particulates deposited on street surfaces, such as paper, vegetation residues, animal feces, bottles and broken glass, plastics and fallen leaves. Litter-control programs can reduce the amount of deposition of pollutants by as much as 50%, and may be an effective measure of controlling pollution by storm runoff.		X		
Livestock water crossing facility: Providing a controlled crossing for livestock and/or farm machinery in order to prevent streambed erosion and reduce sediment.	X		100 %[1]	
Manufactured BMP systems: Structural measures which are specifically designed and sized by the manufacturer to intercept stormwater runoff and prevent the transfer of pollutants downstream. They are used solely for water quality enhancement in urban and ultra-urban areas where surface BMPs are not feasible.	X	X		
Onsite treatment system installation: Conventional onsite wastewater treatment and disposal system (onsite system) consists of three major components: a septic tank, a distribution box, and a subsurface soil absorption field (consisting of individual trenches). This system relies on gravity to carry household waste to the septic tank, move		X		

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE		Reported EFFICIENCY	NOTE
	AGRICULTURE	URBAN		
effluent from the septic tank to the distribution box, and distribute effluent from the distribution box throughout the subsurface soil absorption field. All of these components are essential for a conventional onsite system to function in an acceptable manner.				
Porous pavement: An alternative to conventional pavement, it is made from asphalt (in which fine filler fractions are missing) or modular or poured-in concrete pavements. Its use allows rainfall to percolate through it to the sub-base, providing storage and enhancing soil infiltration that can be used to reduce runoff and combined sewer overflows. The water stored in the sub-base then gradually infiltrates the subsoil.		X	50 %[1]	
Proper site selection for animal feeding facility: Establishing or relocating confined feeding facilities away from environmentally vulnerable areas such as sinkholes, streams, and rivers in order to reduce or eliminate the amount of pollutant runoff reaching these areas.	X			
Rain garden /bio-retention basin: Rain gardens are landscaped gardens of trees, shrubs, and plants located in commercial or residential areas in order to treat stormwater runoff through temporary collection of the water before infiltration. They are slightly depressed areas into which storm water runoff is channeled by pipes, curb openings, or gravity.		X	40 %[1]	
Range and pasture management: Systems of practices to protect the vegetative cover on improved pasture and native rangelands. It includes practices such as seeding or reseeding, brush management (mechanical, chemical, physical, or biological), proper stocking rates and proper grazing use, and deferred rotational systems.	X		50 %[1]	
Wet retention ponds/basins: A storm water facility that includes a permanent pool of water and, therefore, is normally wet even during non-rainfall periods. Inflows from storm water runoff may be temporarily stored above this permanent pool.	X	X	32 %[1] 70%[4]	
Riparian buffer zones: A protection method used along streams to reduce erosion, sedimentation, and the pollution of water from agricultural non-point sources.	X	X	43 – 57 %[1]	Forested buffer w/o incentive payment
Septic system pump-out: A typical septic system consists of a tank that receives waste from a residence or business, and a drain field or subsurface absorption system		X	5 %[1]	

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE		Reported EFFICIENCY	NOTE
	AGRICULTURE	URBAN		
consisting of a series of percolation lines for the disposal of the liquid effluent. Solids (sludge) that remain after decomposition by bacteria in the tank must be pumped out periodically.				
Sewer line maintenance (e.g., sewer flushing): Sewer flushing during dry weather is designed to periodically remove solids that have deposited on the bottom of the sewer and the biological slime that grows on the walls of combined sewers during periods of low-flow. Flushing is especially necessary in sewer systems that have low grades which has resulted in velocities during low-flow periods that fall below those needed for self-cleaning.		X		
Stream bank protection and stabilization (e.g., riprap, gabions): Stabilizing shoreline areas that are being eroded by landscaping, constructing bulkheads, riprap revetments, gabion systems, or establishing vegetation.	X	X	40 - 75 %[1]	40 % w/o fencing; 75 % w/ fencing
Street sweeping: The practice of passing over an impervious surface, usually a street or a parking lot, with a vacuum or a rotating brush for the purpose of collecting and disposing of accumulated debris, litter, sand and sediments. In areas with defined wet and dry seasons, sweeping prior to the wet season is likely to be beneficial; following snowmelt and heavy leaf fall are also opportune times.		X		
Terrace: An earth embankment, or a combination ridge and channel, constructed across the field slope. Terraces can be used when there is a need to conserve water, excessive runoff is a problem, and the soils and topography are such that terraces can be constructed and farmed with reasonable effort.	X	X		
Vegetated filter strip: A densely vegetated strip of land engineered to accept runoff from upstream development as overland sheet flow. It may adopt any naturally vegetated form, from grassy meadow to small forest. The purpose of a vegetated filter strip is to enhance the quality of stormwater runoff through filtration, sediment deposition, infiltration and absorption.	X	X	<30% [3]	
Waste system/storage (e.g., lagoons, litter shed): Waste treatment lagoons biologically treat liquid waste to reduce the nutrient and BOD content. Lagoons must be emptied and their contents disposed of properly.	X	X	80 – 100 %[1]	
Water treatment (e.g., disinfection, flocculation, carbon filter system) : Physical, chemical and/or biological processes used to treat concentrated discharges. Physical-	X	X		

BEST MANAGEMENT PRACTICE	IMPAIRMENT SOURCE		Reported EFFICIENCY	NOTE
	AGRICULTURE	URBAN		
chemical processes that have been demonstrated to effectively treat discharge include sedimentation, vortex separation, screening (e.g., fine-mesh screening), and sand-peat filters. Chemical additives used to enhance separation of particles from liquid include chemical coagulants such as lime, alum, ferric chloride, and various polyelectrolytes. Biological processes that have been demonstrated to effectively treat discharges include contact stabilization, biodiscs, oxidation ponds, aerated lagoons, and facultative lagoons.				
Wetland development/enhancement: The construction of a wetland for the treatment of animal waste runoff or storm water runoff. Wetlands improve water quality by removing nutrients from animal waste or sediments and nutrients from storm water runoff.	X	X	30 %[1] 78%[4]	Including creation and restora-tion

Sources

1 BMP Efficiencies Chesapeake Bay Watershed Model (PhaseIV) August 1999; Draft FC and Nitrate TMDL IP for Dry River (2001); EPA (1998); EPA(1999b); Novotny (1994); Storm Water BestManagement Practice Categories and Pollutant Removal Efficiencies (2003); USDA (2003); DCR (1999); DEQ/DCR (2001).

2 Barrett,M.E.,ComplyingwiththeEdwardsAquiferRules:TechnicalGuidanceonBestManagementPractices,TexasNaturalResourceConservationCommissionReportRG-348,June,(1999).

3 The Expected Pollutant Removal (Percent) Data Adapted from US EPA, 1993C.

4 National Pollutant Removal Performance Database, Version 3, September, 2007

APPENDIX F

REPONSE TO COMMENTS

A: Comments from Mr. Quang Pham, P.E., Agricultural Environmental Management Division, Oklahoma Department of Agriculture Foods and Forestry (405-522-3553)

A1: Page 3-1, section 3.1 NPDES-Permitted Facilities, 3rd paragraph, last sentence "CAFOs are recognized by USEPA as significant sources of pollution, and may have potential to cause serious impact to water quality if not properly managed". We strongly recommend that the following languages, as suggested and accepted by DEQ for use in the Turbidity TMDL reports, be put in use in Bacteria TMDL reports as well : "CAFOs are recognized by USEPA as potential significant sources of pollution, and may cause serious impacts to water quality if not properly managed";

Response: Changes were made.

A2: Page 3-7, section 3.1.4 CAFOs, 2nd paragraph, 1st sentence "CAFOs are designated by USEPA as significant sources of pollution, and may have potential to cause serious impact to water quality if not properly managed". We also recommend that the languages accepted by DEQ for use in the Turbidity TMDL reports be put in use instead: "CAFOs are recognized by USEPA as potential significant sources of pollution, and may cause serious impacts to water quality if not properly managed".

Response: Changes were made.

B: Comments from Harlan Hentges, Attorney at Law, on behalf of Floyd Driever, Shirley Driever, Larry Bernhardt, Jacquita Bernhardt, Richard Davis, Valerie Davis, and Strack Wheat & Cattle.

B1: The omitted CAFO is operated by Wheeler Brother, Inc. It is located three miles east and one mile north of the intersection of state highway 3 and interstate highway 281 in Watonga, Blaine County, Oklahoma. The Wheeler Brothers' CAFO is permitted for 40,000 head of cattle and currently maintains a population of approximately 30,000 head. This is one of the largest CAFO's in the state outside of the Panhandle.

The enclosed aerial photograph from the Oklahoma Department of Environmental Quality shows the location of the feedlot and the location of the separation of the Cooper Creek watershed from the Kingfisher Creek Watershed and the Canadian River Watershed. The northeast portion of the CAFO's pens is in the Cooper Creek watershed. In addition to the pens, the CAFO stock piles manure in the area north of the pens. The area in which the manure is piled is not within the drainage of any berms or lagoons and the manure saturated water flows northeast from the CAFO across the Driever property and into Cooper Creek. The direction of flow)s indicated in the attached photographs.

Response: This CAFO (Permit ID OKG010081) is partially located inside Cooper Creek watershed, although its latitude and longitude description reflected in ODAFF(Oklahoma Department of Agriculture, Food and Forestry)'s database puts it just outside the Cooper Creek watershed. ODAFF noted that their land application sites are outside of the Cooper Creek watershed. As a result of this comment, OKG010081 was added to the report in Section 3.1.4 and related description in other places of the report was also modified to reflect this change.

B2: The presence of the Wheeler Brothers CAFO in the Cooper Creek watershed renders inaccurate:

• page xii of the Executive Summary which states "There are no NPDES-permitted facilities of any type in the contributing watersheds of ... Cooper Creek ....).

• page 3-1 which states "There are no NPDES-permitted facilities of any type in the contributing watersheds of ... Cooper Creek. . ..) .

• figure 3-1 which purports to depict the location of CAFOs in the study area, but does not show the location of the Wheeler Brothers feedlot.

Response: Changes were made.

B3: On page 3-7 the report states, "AEMS works with producers and concerned citizens to ensure that animal waste does not impact the waters of the state." The permit for the Wheeler Brothers feedlot was expanded by the Oklahoma Department of Agriculture from 20,000 head to 45,000 head without any review by any person at the ODAFF. Attached is the application submitted by Wheeler to ODAFF and the approval by the ODAFF. It reveals that the applicant simply crossed out 20,000 and wrote in 45,000. The AEMS director then wrote "OK." This total absence of regulatory oversight is entirely inconsistent with the statement on page 3-7 of the report. In order to make the statement accurate we would urge the report to acknowledge that at least in this instance pertaining to the Cooper Creek Watershed, the ODAFF did not exercise any over sight in regard to the more than doubling of the capacity of this feedlot.

Response: EPA and ODAFF are in the process of monitoring this facility. The Oklahoma TMDL development process does not evaluate regulatory actions. Your comment was forwarded to the ODAFF for their consideration. Since this comment is not specifically about the TMDL, no change was made as a result of this comment.

B4: On page 3-10 the report states "Processed commercially raised farm animal manure is often applied to fields as fertilizer and can contribute to fecal bacteria loading to water bodies if washed into streams by runoff." While the report generally acknowledges this source of pollution it does not address the fact that the most significant source of such animal manure in the study area is the Wheeler Brothers CAFO. For example, large amounts of manure from Wheeler Brothers CAFO are dumped on the property one half mile northeast of the CAFO. Cooper Creek runs through this property.

Response: Monitoring of the compliance status of the facility is ongoing. If indicated, appropriate enforcement action would be taken on CAFO OKG0100081 by EPA and OADFF. However, statements made regarding CAFO in the report remain true. No change was made as a result of this comment.

B5: On page 3-10 the reference to Table 3"5 is incorrect. It should be Table 3-7.

Response: Change was made.

B6: Page 3-14 of the report purports to address illicit discharges. Due to the omission of the Wheeler Brothers' CAFO from the study, any illicit discharges by Wheeler Brothers are not considered. The Wheeler Brothers CAFO is the subject of an EPA Region 6 investigation under Docket Number CWA-06-2007-1757. The information generated by that investigation would be relevant to the report.

Response: Illicit discharges here do not include CAFO discharges. CAFOs are specifically dealt with in Section 3.1.4 and Section B of Appendix F. No change was made as a result of this comment.

B7: Tables 3-14 and 3-15 on pages 3-16 and 3-17 are inaccurate. These tables indicate that no point sources are in the Cooper Creek watershed. This is inaccurate because the Wheeler Brothers CAFO is located in the Cooper Creek watershed.

In conclusion, the Commenters urge the ODEQ to revise the report to include the fact that there is a large CAFO in the study area. The Cornmenters have first hand and daily experience with the fact that quality of the environment and quality of life on property located in the Cooper Creek watershed and near the Wheeler Brothers CAFO is significantly and negatively impacted by this CAFO. Commenters believe that by omitting this CAFO, this report ignores a very large and the most significant source of water pollution in the study area. The conclusions of the report, its analysis and any action taken in reliance on the report will be flawed unless this existence of the CAFO is incorporated into the study.

Response: "Point source" in Table 3-14 strictly refers to NPDES-permitted wastewater treatment facilities. CAFOs are listed in Table 3-4, page 3-7 of the report. Please see responses to Comments 1-3 regarding the Wheeler Brothers CAFO. Table 3-15 does account for CAFOs. The title of Table 3-15 has been changed to "Summary of Fecal Coliform Load Estimates from Various Sources to Land Surfaces".

C: Comments from Ms. Marsha Slaughter, P.E., Oklahoma City Water Utilities Trust.

C1: For clarification, how were target screening levels in Oklahoma Administrative Code (OAC) 785:46 developed? Were these screening level targets recommended by EPA? Are the screening levels used in other similar Oklahoma waters?

Response: The Oklahoma TMDL development process does not evaluate or interpret established water quality standards or their implementation rules. Please contact the Oklahoma Water Resources Board (OWRB) on questions regarding the development of the screening levels. Your comment was forwarded to OWRB for consideration. No change was made as a result of this comment.

C2: Are all waters of the state classified as primary body contact recreation (PBCR) as described in OAC 785:45? Additional background information would be helpful for the OCWUT regarding the classification of the stream as PBCR.

Response: No. Specific use designations are made by the Oklahoma Water Resources Board for waters of the state. Please contact the OWRB for information. No change was made as a result of this comment.

C3: River monitoring data for the identification of the TMDL was collected in 2000 and 2001. Using this database, only nine data points were considered in the evaluation of discharges to Deer Creek. All data points examined 2000 were above screening criteria. Is additional data available representative of the more current conditions in the receiving streams?

Response: DEQ received monitoring data from various state agencies. No additional data were found for Deer Creek. No change was made as a result of this comment.

C4: Table 3-1 does not include the NPDES permit from the Bluff Creek Water Pollution Control Facility (OK0026077) but lists it in Table 3-2 as a non-discharging facility. This facility/plant current discharges to Deer Creek. OCWUT requests that the data from this plant be considered in the development of the TMDL.

Response: Facility OK0026077 discharges into Bluff Creek. Bluff Creek is also impaired for bacteria and will be subject to a TMDL in the future. Facility OK0026077 will be included in the Bluff Creek TMDL. As a result of this comment, facility OK0026077 (Facility ID S20925) was removed from Table 3-2 and Table 3-3.

C5: ODEQ identified sanitary sewer overflow (SSO) events on page ES-6 as potential sources of bacteria load. SSO events are typically high flow short duration events impacting the instantaneous standards. Was a correlation completed to identify impacts during storm/wet weather days?

Response: No correlation was done specifically for this TMDL. However, SSO events as potential sources of bacteria load is a well established fact (see EPA documentation at http://www.epa.gov/Region06/6en/w/sso/ssodesc.htm). No change was made as a result of this comment.

C6: Page xii appears to have an error listing Table 3-13 instead of Table 3-14

Response: Change was made.

C7: Census data from 2000 page 1-3 was used to develop the populations for each of the counties. Can the data be adjusted to reflect 2009 conditions?

Response: Census 2000 was the latest available census data. We will update the information when the new Census 2010 data become available. No change was made as a result of this comment.

C8: Please add a description or reference for the fecal coliforms, E. Coli, and enterococci test methods to verify that these methods will be the same as used in operation.

Response: EPA approved methods are used. A list of the methods can be found at 40 CFR 136. DEQ used the same set of data for the state water quality assessment process (CWA 305(b) and 303(d)) in preparing the TMDLs. Please contact the Oklahoma Water Resources Board and the Oklahoma Conservation Commission regarding the bacteria test methods they used for their water samples. No change was made as a result of this comment.

C9: Page 4-3 indicates that no flow gage exists for Deer Creek. Data from the station along Cottonwood Creek was used and included flow data from 1977 through 1989. Since economic growth has occurred in the watershed since 1989, data from 1990 through 2009 needs to be used to more accurately estimate flow in Deer Creek.

Response: The station on Cottonwood Creek (USGS station ID: 07159720) ceased operation on Sept. 30, 1989. No additional data were available after that date. No change was made as a result of this comment.