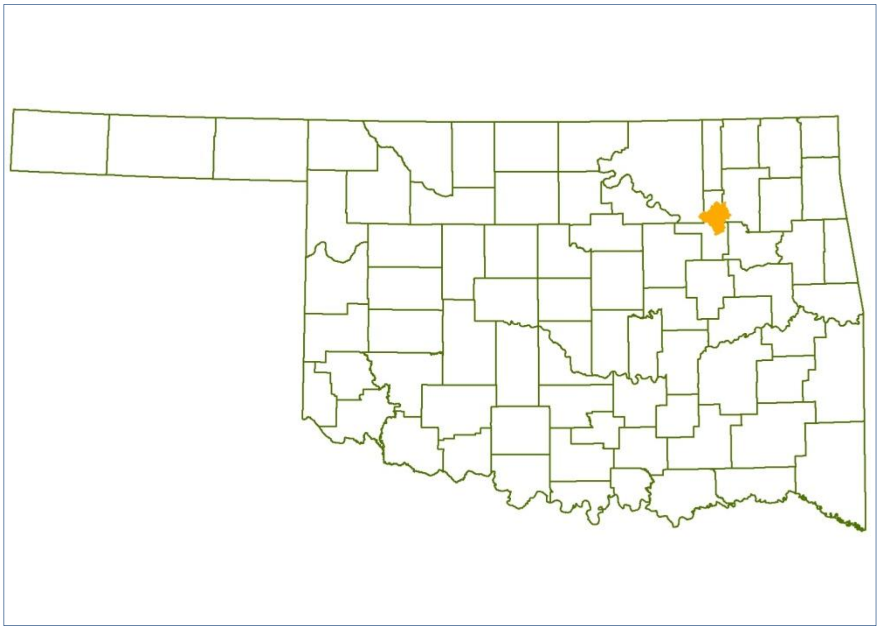
# FINAL

# BACTERIA TOTAL MAXIMUM DAILY LOADS FOR THE LOWER BIRD CREEK WATERSHED AREA (OK121300010010_00)



*Prepared by:*

## INDIAN NATIONS COUNCIL OF GOVERNMENTS

## OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY

**JULY 2011**

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**OKWBID**

OK121300010010_00, OK121300010090_00

OK121300010060_00

*Prepared by:*

**INDIAN NATIONS COUNCIL OF GOVERNMENTS**

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**OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY**

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**JULY 2011**

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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(s) |
| 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)*, and Enterococci within the Lower Bird Creek watershed. Elevated levels of pathogen indicator bacteria in aquatic environments indicate that a receiving waterbody 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 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.

## *E.1 Problem Identification and Water Quality Target*

A decision was made to place the three waterbodies, 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 any of the three bacterial indicators resulted 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 these waterbodies.

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

| Waterbody ID | Waterbody Name | Stream Miles | Category | Priority | TMDL Date | Primary Body Contact Recreation | Fecal Coliform | *E.coli* | Enterococci |
|---|---|---|---|---|---|---|---|---|---|
| OK121300010010_00 | Bird Creek (Lower) | 23.8 | 5a | 1 | 2010 | N | X | X | X |
| OK121300010090_00 | Coal Creek | 6.71 | 5a | 1 | 2010 | N | | X | |
| OK121300010060_00 | Ranch Creek | 6.94 | 5a | 1 | 2010 | N | | X | |

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

There are two bacteria monitoring programs for which data were used in this report for the Lower Bird Creek. The first is the OWRB's Beneficial Use Monitoring Program (BUMP) site at Highway 266 bridge (OWRB BUMP ID OK121300010010-001AT), the same location as the USGS stream gage. The only bacteria BUMP data for this site was during 2006, and all three indicators were monitored during this time. The second data set was from stream monitoring by the City of Tulsa, but only fecal coliform data was monitored by Tulsa. Tulsa's fecal coliform data from 2005 to 2009 from the nearest site to the BUMP station was used. This site is labeled by Tulsa as site BC-5b. For the fecal coliform dataset, the Tulsa 2005-09 and OWRB 2006 data were combined into a single data set. For the data collected between 2005 and 2009 and the re-assessment for PBCR use conducted for this study, evidence of nonsupport of the PBCR use based upon all three indicators was observed in the waterbody. There is one Oklahoma Conservation Commission monitoring site each on Coal and Ranch Creeks.

Table ES-2 summarizes the waterbodies requiring the TMDLs for not supporting PBCR as a result of the data re-assessment by this study. Only data from each year's primary contact recreation period (May 1 through September 30) was used in the assessment and TMDLs. The data summary in Table ES-2 provides a general understanding of the amount of water quality data available and the severity of exceedances of the water quality criteria. This data set includes the data used to support the decision to place specific waterbodies within the Study Area on the ODEQ 2008 303(d) list (ODEQ 2008). It also includes the new date collected after the data cutoff date for the 2008 303(d) list.

**Table ES-2 Summary of Indicator Bacteria Samples from Primary Contact Recreation Season, 2003-2009***

| 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 | Notes** |
|---|---|---|---|---|---|---|---|---|
| OK121300010010_00 | Bird Creek (Lower) | FC | 400 | 367 | 54 | 23 | 43% | TMDL needed |
| | | EC | 406 | 205 | 10 | 4 | 40% | TMDL needed |
| | | ENT | 108 | 170 | 10 | 5 | 50% | TMDL needed |
| OK121300010090_00 | Coal | EC | 406 | 271 | 10 | 4 | 40% | TMDL needed |
| OK121300010060_00 | Ranch | EC | 406 | 167 | 13 | 4 | 31% | TMDL needed |

EC = *E. coli*; ENT = Enterococci; FC = fecal coliform.
*2005-2009 for Bird Creek (Lower).
**Highlighted bacteria indicators require TMDL.

The definition of PBCR is summarized by the following excerpt from Chapter 45 of the Oklahoma WQS (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 1$^{st}$ to September 30$^{th}$) 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 three NPDES-permitted municipal wastewater treatment plants (WWTPs) in the contributing watersheds of Lower Bird Creek (OK121300010010_00). There are no WWTPs in the contributing watersheds of the Coal (OK121300010090_00) and Ranch (OK121300010060_00) Creeks.

There are 4 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 a total of 923 SSO occurrences within the Study Area, ranging from 2 gallons (negligible amount) to > 8 million gallons between October 2004 and October 2009. The average reported release flow volume was 87,083 gallons during this five year period. Given the significant number of occurrences and the size of overflows reported, SSOs could be a significant source of bacteria loading to streams in the study area.

The City of Tulsa, located partially in the watershed, falls under requirements designated by USEPA for inclusion in the Phase I stormwater program. The small MS4 General Permit for communities in Oklahoma became effective on February 8, 2005. There are three cities and one county in the Study Area that fall under requirements designated by USEPA for inclusion in the Phase II Stormwater Program. These are (with their percent of watershed as MS4 in parentheses): Catoosa (2.5%), Owasso (7.8%), Broken Arrow (0.7%), and Tulsa County (3.4%). The Coal Creek watershed has two small areas that are part of Tulsa County's MS4 responsibility (Figure 3-1b). The Ranch Creek watershed has City of Owasso and Tulsa County as its MS4 communities occupying a combined 32.5% of the area. There are no NPDES-permitted concentrated animal feeding operations (CAFOs) within the Study Area.

Within the Lower Bird Creek watershed, the three WWTP point sources are relatively minor contributors of bacteria and for the most part tend to meet instream water quality criteria in their effluent due to disinfection of effluent. Therefore, nonpoint sources and other point sources such as the municipal separate storm sewer systems (MS4s) areas in the watershed are considered to be the major origins of bacteria loading.

The four major nonpoint source categories contributing to the elevated bacteria in each of the watersheds in the Study Area are livestock, pets, deer, and septic tanks. Livestock and domestic pets are estimated to be the largest 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.

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 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.

## *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 shown that bacteria loading in streams during low flow conditions may be due to wildlife in rural and urban areas (such as birds, raccoons, possums, etc.), pets and other domesticated animals, 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.

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.

For bacteria TMDLs 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***

## *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:

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

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 the Study Area. 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 WQS 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. The appropriate PRG for each bacteria indicator for each waterbody in the study area is denoted by the bold text in Table ES-3. The PRGs range from 44.8 to 82.6 percent. Because the Coal and Ranch Creeks are tributaries to the Lower Bird Creek and because the load reduction goals for the Coal and Ranch Creeks are either equal or smaller than that for the Lower Bird Creek for *E. Coli*, the more restrictive load reduction goal of 44.8% for the Lower Bird Creek will apply to these two tributaries.

**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 | |
| | | | Instant-aneous | Instant-aneous | Geo-mean | Instant-aneous | Geo-mean |
| OK121300010010-001AT | OK121300010010_00 | Bird Creek (Lower) | **64.1%** | 79.1% | **44.8%** | 94.4% | **82.6%** |
| OK121300-01-0090M | OK121300010090_00 | Coal Creek | | **44.8%†** | 58.6% | | |
| OK121300-01-0060G | OK121300010060_00 | Ranch Creek | | 85.3% | **32.8%†** | | |

† Because these two values are either equal or smaller than that for the Lower Bird Creek for *E. Coli*, the more restrictive load reduction goal of 44.8% for the Lower Bird Creek will apply to these two tributaries.

The TMDL, WLA, LA, and MOS vary with flow condition, and are calculated at every 5th flow interval percentile. For illustrative purposes, the TMDL, WLA, LA, and MOS are calculated for the median flow 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 within the study watershed. The LDC and the equation of:

***Average LA = average TMDL - MOS - WLA_WWTF - 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. Where there are no continuous point sources the WLA is zero.

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 lack of knowledge associated with calculating the allowable pollutant loading to ensure WQS 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. An explicit Margin of Safety of 10% was selected in this TMDL report.

## 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.

**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) |
|---|---|---|---|---|---|---|---|---|
| OK121300010010_00 | OK121300010010_001AT | Bird Creek (Lower) | ENT | 8.11E+11 | 6.41E+10 | 4.41E+11 | 2.25E+11 | 8.11E+10 |
| OK121300010090_00 | OK121300-01-0090M | Coal Creek | EC | 1.79E+10 | 0.00E+00 | 1.61E+10 | 0.00E+00 | 1.79E+09 |
| OK121300010060_00 | OK121300-01-0060G | Ranch Creek | EC | 4.59E+10 | 0.00E+00 | 1.34E+10 | 2.79E+10 | 4.59E+09 |

† Derived for illustrative purposes at the median flow value

# 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)*, and Enterococci for the 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 the 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 watershed, tribes, and local, state, and federal government agencies.

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

- Lower Bird Creek (OK121300010010_00),
- Coal Creek (OK121300010090_00), and
- Ranch Creek (OK121300010060_00).

Figures 1-1a and 1-1b are the location maps showing the impaired segments of the waterbodies and their contributing watersheds. The maps also display the locations of the water quality monitoring (WQM) station used as the basis for placement of the waterbodies on the Oklahoma 303(d) list and other related information. The waterbodies and the surrounding watersheds are hereinafter referred to as the Study Area. The Study Area, which is comprised of the watershed for all of Lower Bird Creek, also includes the two sub-watersheds of Coal Creek and Ranch Creek (Figure 1-1b) that are also impaired for bacteria. Both of these segments are listed in the 2008 303(d) list as impaired for *E. coli*. The TMDL load reductions calculated for the entire Lower Bird Creek watershed will apply to them as well. Separate TMDLs for the two tributaries are also prepared in this report. The more restrictive TMDL reduction goals will apply to these two tributaries.

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 2008 303(d) Listing Decision**

| Waterbody Name | Waterbody ID | WQM Station | WQM Station Location Descriptions |
|---|---|---|---|
| Bird Creek (Lower) | OK121300010010_00 | OK121300010010-001AT | Bird Creek, Hwy 266 bridge |
| Coal Creek | OK121300010090_00 | OK121300-01-0090M | Coal Creek: Hwy 11 |
| Ranch Creek | OK121300010060_00 | OK121300-01-0060G | Ranch Creek: Owasso |

## 1.2 Watershed Description

**General.** The watershed of Lower Bird Creek addressed in these TMDLs is located in northeast Oklahoma. The waterbodies addressed in this report are located in portions of Tulsa, Osage and Rogers Counties.

Within the Level IV ecoregion classification, nearly all of the study area falls into the Central Irregular Plains ecoregion. The Central Oklahoma/Texas Plains ecoregion is on the western tip of the watershed.

Table 1-2, derived from the 2000 U.S. Census, demonstrates that with the exception of the metropolitan City of Tulsa portion of the watershed in Tulsa County, the remainder of 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) |
|---|---|---|
| Tulsa | 563,303 | 988.2 |
| Osage | 44,433 | 19.7 |
| Rogers | 70,640 | 104.7 |

**Climate.** Table 1-3 summarizes the average annual precipitation for the Lower Bird Creek watershed. The annual precipitation within the watershed in this portion of Oklahoma ranges between 39.8 (Osage County) and 44.0 (Rogers County) inches, increasing from the west to east (Oklahoma Climatological Survey, 2005).

**Table 1-3 Average Annual Precipitation by Watershed**

| Study Area Precipitation Summary | | |
|---|---|---|
| **Waterbody Name** | **Waterbody ID** | **Average Annual (Inches)** |
| Bird Creek (Lower) | OK121300010010_00 | 41.9 |
| Coal Creek | OK121300010090_00 | 41.9 |
| Ranch Creek | OK121300010060_00 | 41.9 |

**Land Use.** Table 1-4 summarizes the acreages and the corresponding percentages of the land use categories for the contributing watersheds associated with the waterbodies in the Study Area. 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.

In the Lower Bird Creek watershed, the largest percentage land use category (20.2%) is for Developed Low Density. Several mostly rural land use categories (around 13% to 16% each) are the next dominant: Developed Open Space, Deciduous Forest, Grasslands/Herbaceous, and Pasture/Hay. Combined, these mostly vegetative land uses comprise nearly two-thirds (59.9%) of the watershed. Developed High Density is another 7.5% of the watershed, with the remaining categories under 2% each or not present.

Coal Creek is mostly an urban watershed with 67% of the land classified as developed. Ranch Creek, on the other hand, is mostly a rural watershed with forest, grassland, and pasture accounting for 75% of the total watershed area.

The City of Tulsa lies within 51.8% of the Lower Bird Creek watershed. Owasso is 7.8 % of the watershed, Catoosa 2.5%, and Broken Arrow 0.7%. The rest is unincorporated county land. All of these cities are Phase II stormwater permitted cities except Tulsa which has a Phase I permit. Tulsa County also has a Phase II stormwater permit, and its permitted Urbanized Area occupies 3.4% of the Lower Bird Creek watershed. Together, about two-thirds (66.2%) of the watershed is made up of stormwater permitted areas. The Coal Creek watershed lies almost entirely within the City of Tulsa while about one third of the Ranch Creek watershed is within the City of Owasso.

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

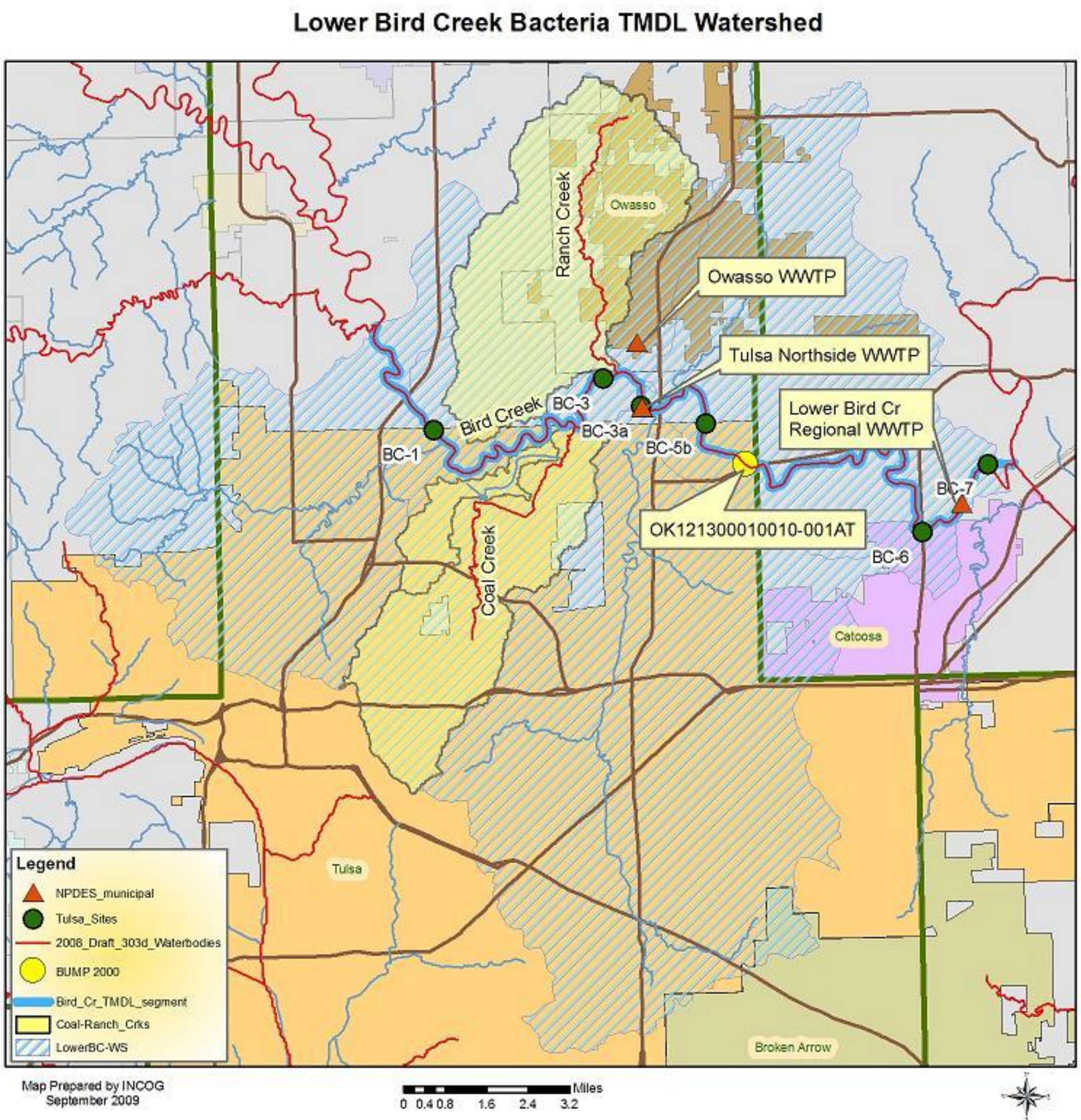


**Figure 1-1b Coal and Ranch Creek Watersheds**

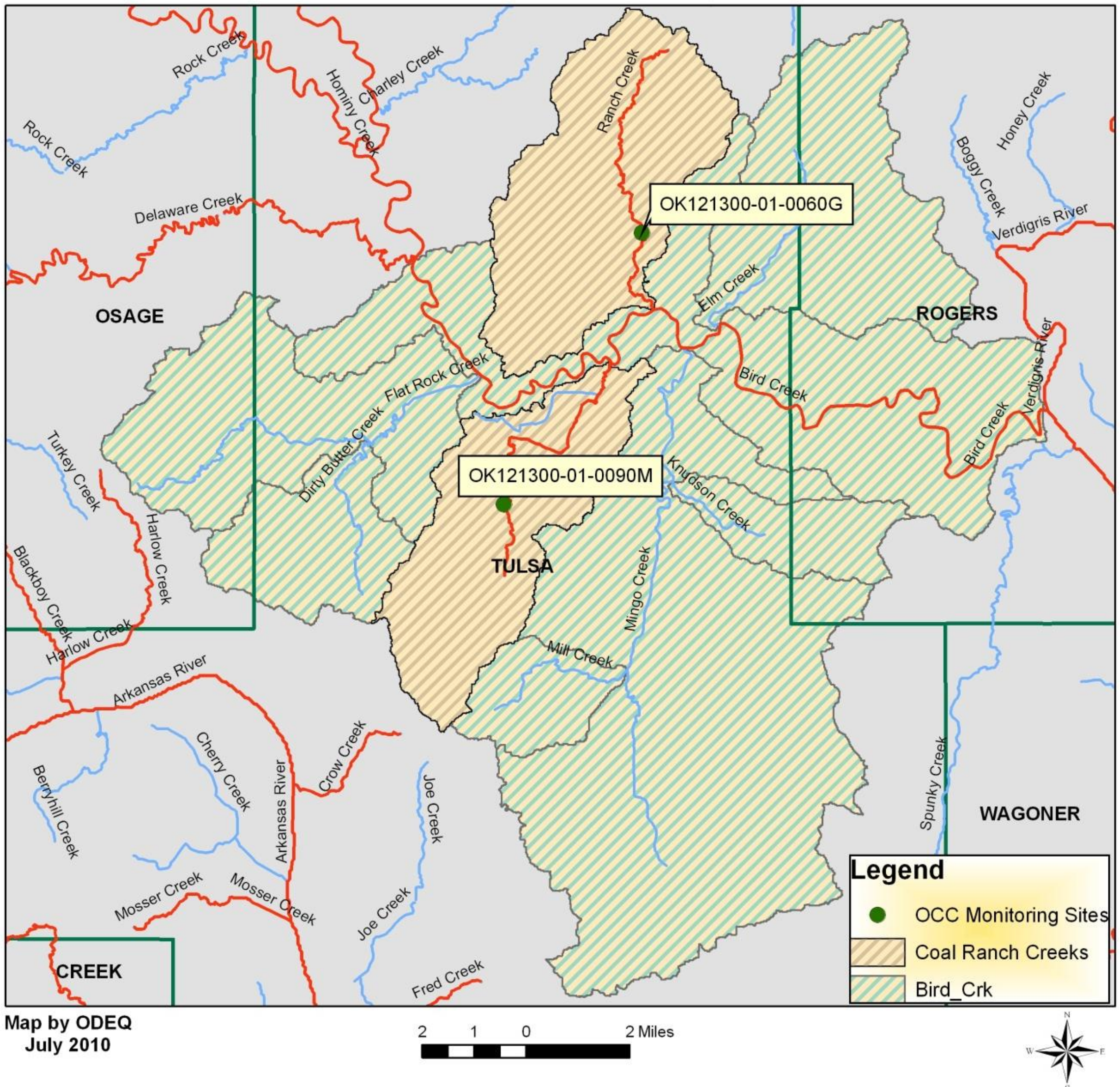
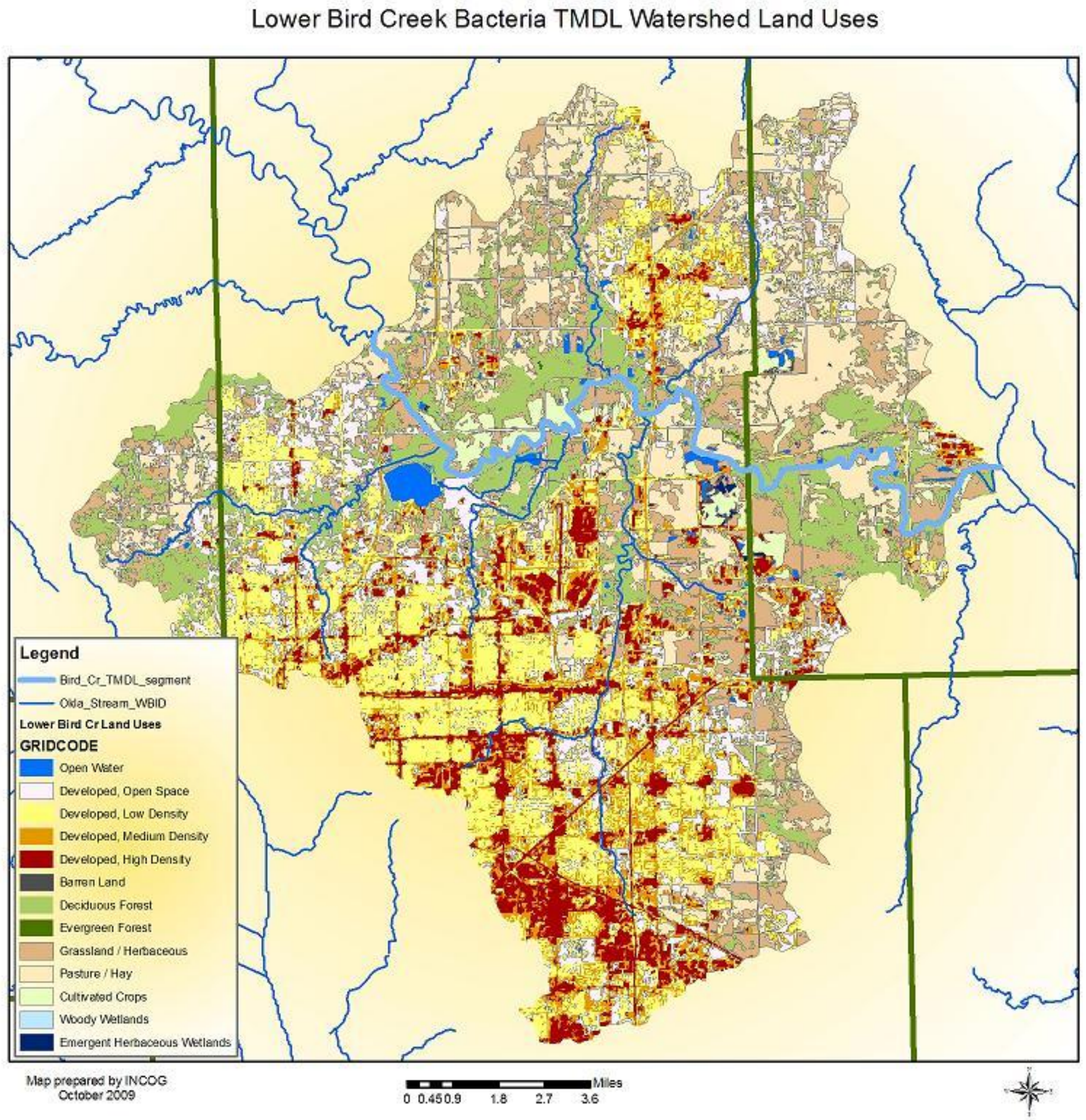


**Table 1-4 Land Use Summaries by Watershed**

| Grid Code | Category Description | Bird Creek (Lower) | | Coal Creek | | Ranch Creek | |
|---|---|---|---|---|---|---|---|
| | | Acres | Percent | Acres | Percent | Acres | Percent |
| 11 | Open Water | 3832.7 | 3.3 | 1621.1 | 14.2 | 388.4 | 3.1 |
| 21 | Developed, Open Space | 17,456.6 | 15.2 | 2,002.5 | 19.0 | 1,267.5 | 10.2 |
| 22 | Developed, Low Density | 22,689.3 | 19.7 | 0 | 0 | 0 | 0 |
| 23 | Developed, Medium Density | 10,716.4 | 9.3 | 3,876.9 | 36.9 | 1,003.7 | 8.1 |
| 24 | Developed, High Density | 8,386.9 | 7.3 | 1,164.7 | 11.1 | 105.0 | 0.9 |
| 31 | Barren Land (Rock/Sand/Clay) | 69.1 | 0.1 | 0 | 0 | 0 | 0 |
| 41 | Deciduous Forest | 14,736.7 | 12.8 | 1,129.1 | 10.7 | 2,367.9 | 19.1 |
| 42 | Evergreen Forest | 25.0 | 0.0 | 0 | 0 | 3.1 | 0.03 |
| 71 | Grassland / Herbaceous | 17,251.2 | 15.0 | 541.3 | 5.2 | 2,899.6 | 23.4 |
| 81 | Pasture / Hay | 17,834.6 | 15.5 | 179.5 | 1.7 | 4,009.0 | 32.4 |
| 82 | Cultivated Crops | 1,923.9 | 1.7 | 0 | 0 | 326.9 | 2.6 |
| 90 | Woody Wetlands | 1.9 | 0.002 | 2.0 | 0.02 | 0 | 0 |
| 95 | Emergent Herbaceous Wetlands | 0.2 | 0.0 | 0 | 0 | 2.2 | 0.02 |
| | TOTAL: | 114,924 | 100 | 10,517 | 100 | 12,373 | 100 |

*Data Source: USGS 2001 National Land Cover Database Zone 32 Land Cover Layer developed by the Multi-Resolution Land Characteristics (MRLC) Consortium.*

**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). Table 2-1a, an excerpt from the 2008 Integrated Report (ODEQ 2008), lists beneficial uses designated for each impaired stream segment in this TMDL. The TMDLs in this report only address the PBCR-designated use.

Tables 2-1a and b, excerpts from Appendix C of the 2008 Integrated Report (ODEQ 2008), summarize the beneficial uses attainment status for the waterbodies in the Study Area and targeted TMDL dates. 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 2-1a. The TMDLs established in this report are a necessary step in the process to restore the PBCR use designation for each waterbody.

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

| Waterbody ID | Waterbody Name | Stream Miles | Category | Priority | TMDL Date | Fecal Coliform | *E.coli* | Enterococci | Primary Body Contact Recreation |
|---|---|---|---|---|---|---|---|---|---|
| OK121300010010_00 | Bird Creek (Lower) | 23.8 | 5a | 1 | 2010 | X | X | X | N |
| OK121300010090_00 | Coal Creek | 6.71 | 5a | 1 | 2010 | | X | | N |
| OK121300010060_00 | Ranch Creek | 6.94 | 5a | 1 | 2010 | | X | | N |

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

**Table 2-1b Designated Beneficial Uses for Each Impaired Streams in the Study Area***

| Waterbody ID | Waterbody Name | AES | AG | WWAC | *FISH* | PBCR | PPWS |
|---|---|---|---|---|---|---|---|
| OK121300010010_00 | Bird Creek (Lower) | I | N | N | F | N | N |
| OK121300010090_00 | Coal Creek | I | I | I | X | N | |
| OK121300010060_00 | Ranch Creek | I | | I | X | N | |

* I: Insufficient information; N: Not supporting; F: Fully supporting; X: not assessed.

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 1$^{st}$ to September 30$^{th}$) 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 1$^{st}$ and September 30$^{th}$ (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 for the most recent 5 years (or the number of years where a total of at least 10 samples were collected) for each indicator bacteria. Water quality data from the primary contact recreation seasons used in this TMDL assessment are provided in Appendix A. The data from three separate monitoring programs were used in this TMDL study. The OWRB's BUMP site at Highway 266 crossing (OK121300010010_001AT) had data for the recreational season for all three bacteria indicators for the Lower Bird Creek, but for only the 2006 season. Therefore, fecal coliform data collected by City of Tulsa at a stream monitoring site (Site BC-5b) approximately 1.5 miles upstream of the BUMP site were also used. The Tulsa site had data for the recreational season for only fecal coliform, but for a five year period of 2005 through July 2009. The fecal coliform data from both the OWRB and City

**Table 2-2 Summary of Indicator Bacteria Samples from Primary Contact Recreation Season, 2003-2009***

| 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** |
|---|---|---|---|---|---|---|---|---|
| OK121300010010_00 | Bird Creek (Lower) | FC | 400 | 367 | 54 | 23 | 43% | No change, TMDL needed |
| | | EC | 406 | 205 | 10 | 4 | 40% | No change, TMDL needed |
| | | ENT | 108 | 170 | 10 | 5 | 50% | No change, TMDL needed |
| OK121300010090_00 | Coal | EC | 406 | 271 | 10 | 4 | 40% | No change, TMDL needed |
| OK121300010060_00 | Ranch | EC | 406 | 167 | 13 | 4 | 31% | No change, TMDL needed |

EC = *E. coli*; ENT = Enterococci; FC = fecal coliform.
*2005-2009 for Bird Creek (Lower).
**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 |
| OK121300010010-001AT | OK121300010010_00 | Bird Creek (Lower) | X | X | X |
| OK121300-01-0090M | OK121300010090_00 | Coal Creek | | X | |
| OK121300-01-0060G | OK121300010060_00 | Ranch Creek | | X | |

ENT = Enterococci; FC = fecal coliform

of Tulsa sites were combined as indicated in Appendix A. For the data collected between 2005 and 2009, evidence of nonsupport of the PBCR use was based on all three bacteria indicators (fecal coliform, E. coli and Enterococcus) observed in the Lower Bird Creek (OK121300010010_00) segment. *E. Coil* data collected by the Oklahoma Conservation Commission (OCC) on the Coal (OK121300010090_00) and Ranch (OK121300010060_00) Creeks showed nonsupport of the PBCR use for both creeks. Table 2-3 summarizes the TMDLs required for the waterbodies 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 the 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.

# 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 significant sources of pollution, and may have the potential to cause serious impacts to water quality if not properly managed.

There are three continuous municipal WWTP point source dischargers and 16 industrial point source dischargers in the Study Area. There also is one MS4 Phase I stormwater permitted city and five Phase II MS4 permittees in the watershed. The MS4 permitted areas are also shown in Figures 3-1a and 3-1b.

### 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 watershed of Lower Bird Creek. For the industrial facilities in Table 3-1 the design flow was not available (N/A).

**Figure 3-1a Locations of NPDES-Permitted Facilities and MS4s in the Bird Creek (Lower) Watershed**

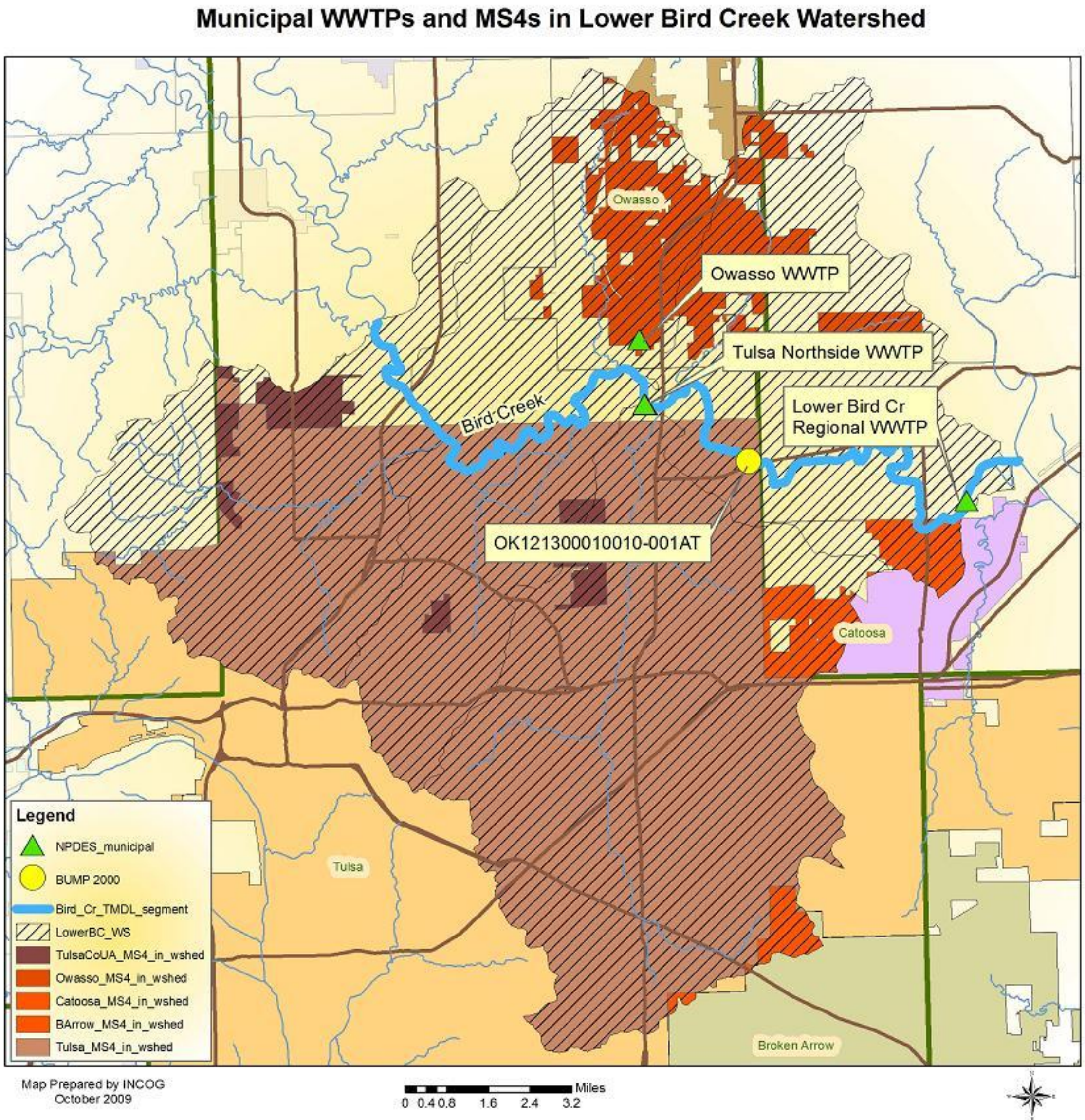


**Figure 3-1b MS4s in the Coal and Ranch Creek Watersheds**

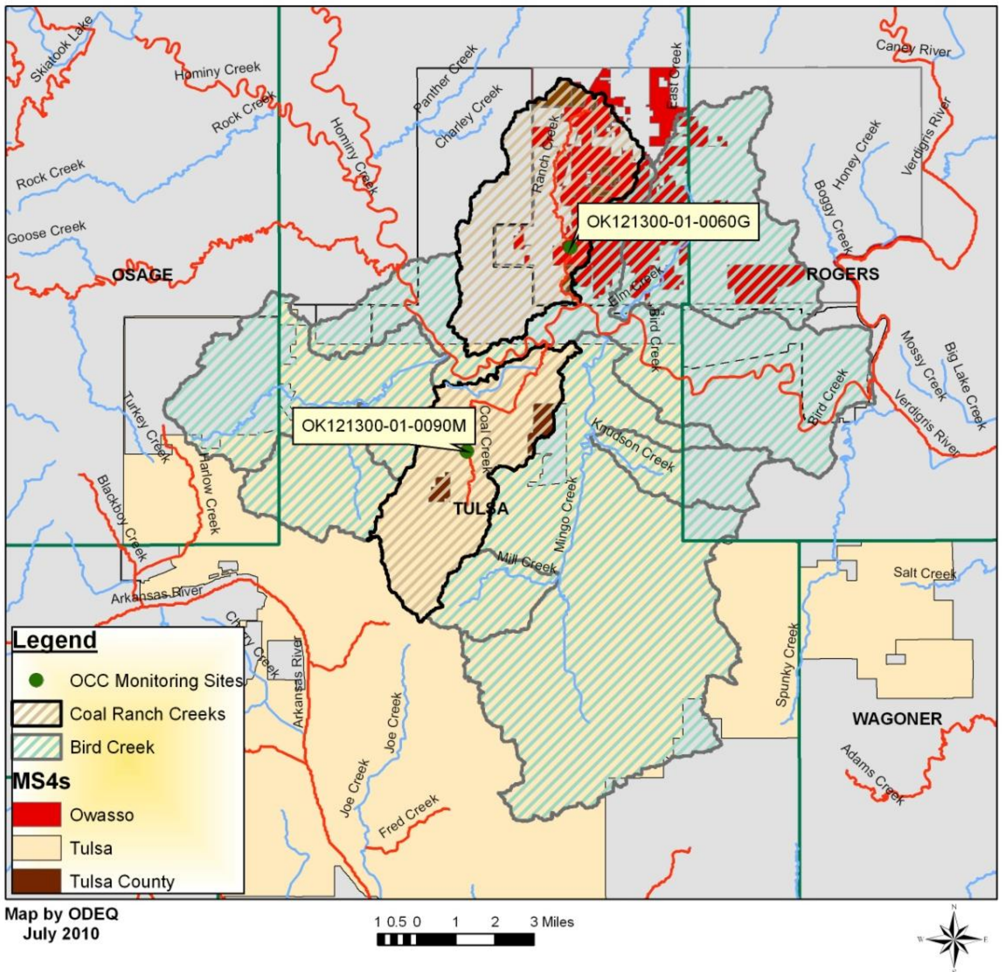


**Table 3-1 Point Source Discharges in the Study Area**

| NPDES Permit No. | Name | Receiving Water | Facility Type | County Name | Design Flow (mgd) | Active/ Inactive | Facility ID |
|---|---|---|---|---|---|---|---|
| OK0020303 | Owasso Public Works Auth. | Unnamed tributary to Bird Creek | Municipal | Tulsa | 3.3 | Active | S21310 |
| OK0026221 | Tulsa MUA Northside | OK121300010010_00 Bird Creek | Municipal | Tulsa | 42.6 | Active | S21309 |
| OK0042935 | Tulsa MUA Lower Bird Cr Regional | OK121300010010_00 Bird Creek | Municipal | Tulsa | 5.41 | Active | S21327 |
| OK0043001 | APAC-Oklahoma, Inc. Tulsa Qur. | Bird Creek watershed | Industrial | Tulsa | N/A | Active | 720000520 |
| OKG110042 | Mid-Continent Concrete Co-Mng | Bird Creek watershed | Industrial | Tulsa | N/A | Active | 72002310 |
| OK0040801 | Anchor Stone Co. Tulsa Rock | Elm Creek watershed | Industrial | Tulsa | N/A | Active | 66001140 |
| OK0001210 | Longview Lake Homeowners Assn. | Mingo Creek watershed | Industrial | Tulsa | N/A | Active | 72002710 |
| OK0001554 | Spirit Aerosystems, Inc. | Mingo Creek watershed | Industrial | Tulsa | N/A | Active | 72000630 |
| OK0031844 | Tulsa International Airport | Coal and Mingo Creek watersheds | Industrial | Tulsa | N/A | Active | 72001420 |
| OK0035351 | Darr Equipment Co, Tulsa | Mingo Creek watershed | Industrial | Tulsa | N/A | Active | 72001270 |
| OK0042374 | US Army Aviation Support Fac. | Mingo Creek watershed | Industrial | Tulsa | N/A | Active | 72002280 |
| OK0044130 | Anchor Stone Co. 36$^{th}$ Street | Mingo Creek watershed | Industrial | Tulsa | N/A | Active | 72002430 |
| OKG110046 | Rainbow Concrete Tulsa Plant | Mingo Creek watershed | Industrial | Tulsa | N/A | Active | 72001700 |
| OK0040789 | LaFarge Building Materials, Inc. | Knudson Creek watershed | Industrial | Tulsa | N/A | Active | 66001770 |
| OK0042447 | Expo Water Park Inc. D/B/A/ Big | Mill Creek watershed | Industrial | Tulsa | N/A | Active | 72001900 |
| OK0040711 | International American Ceramic | Ranch Creek watershed | Industrial | Tulsa | N/A | Active | 72002040 |
| OK0040819 | OK National Guard, Tulsa IAP | Coal Creek watershed | Industrial | Tulsa | N/A | Active | 72002020 |

| NPDES Permit No. | Name | Receiving Water | Facility Type | County Name | Design Flow (mgd) | Active/ Inactive | Facility ID |
|---|---|---|---|---|---|---|---|
| OK0026166 | Tulsa MUA Mohawk Water Plant | Flat Rock Creek watershed | Industrial | Tulsa | N/A | Active | W21601 |
| OK0038695 | Facet International, Inc. | Flat Rock Creek watershed | Industrial | Tulsa | N/A | Active | 72000400 |

N/A = not available

Discharge Monitoring Report (DMR) data was used to determine the number of fecal coliform analyses performed from 1999 through 2009, the maximum concentration during this period, and the number of violations when a daily maximum concentration exceeded 400 cfu/100 mL. DMR data was for fecal coliform only (see Appendix B). These data indicate that there were no geometric mean violations occurring at any of the three municipal WWTPs, and only one WWTP (Lower Bird Creek Regional) had any violations (3) of the maximum concentration occurring during the reporting period in Appendix B.

### 3.1.2 No-Discharge Facilities and SSOs

There are four recorded no-discharge facilities in the Study Area. For the purposes of these TMDLs, no-discharge facilities do not contribute bacteria loading to the Lower Bird Creek 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 |
|---|---|---|---|---|---|
| LEWIS TRAVEL TRAILERS | S21319 | Tulsa | Total Retention | Industrial | Lower Bird Creek OK121300010010_00 |
| RAINBOW CONCRETE COMPANY | N/A | Tulsa | Total Retention | Industrial | Lower Bird Creek OK121300010010_00 |
| TWIN CITIES READY MIX, IN | N/A | Tulsa | Total Retention | Industrial | Lower Bird Creek OK121300010010_00 |
| QUARRY RECYCLING & DISPOS | N/A | Tulsa | Total Retention | Industrial | Lower Bird Creek OK121300010010_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 a total of 923 SSO occurrences within the Lower Bird Creek watershed, ranging from 2 gallons (negligible amount) to > 8 million gallons between October 2004 and October 2009. The average reported release flow volume was 87,083 gallons during this five year period. SSO data are summarized in Table 3-3. 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 Lower Bird Creek watershed.

**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 |
| Owasso | OK0020303 | Unnamed tributary to Bird Creek | S21310 | 158 | 10/1/2004 | 9/30/2009 | 2 | >1,000,000 |
| Lower Bird Creek Regional | OK0042935 | OK121300010010_00 Bird Creek | S21327 | 1 | 2/1/2006 | 2/1/2006 | 510 | 510 |
| Tulsa Northside | OK0026221 | OK121300010010_00 Bird Creek | S21309 | 764 | 9/18/2004 | 9/28/2009 | 6 | >8,000,000 |

SSOs are a common result of the aging wastewater infrastructure around the state. Due to the widespread nature of the SSO problem, DEQ has focused on first targeting 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 normally enters 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 Tulsa (NPDES permit No: OKS000201). The corporate limits constituting Tulsa's permitted MS4 area occupies 51.8% (59,527 acres) of the Lower Bird Creek watershed. The Coal Creek watershed lies entirely within Tulsa's corporate limits. Only a sliver of the Ranch Creek watershed is part of the City of Tulsa. The MS4 areas are shown in Figures 3-1a and 3-1b.

**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. These 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 practicable" (MEP) 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. There are three cities and one county in the Study Area that fall under requirements designated by USEPA for inclusion in the Phase II Stormwater Program. These are (with their percent of watershed as MS4 and NPDES permit numbers in parentheses): Catoosa (2.5%, OKR040033), Owasso (7.8%, OKR040029), Broken Arrow (0.7%, OKR040001), and Tulsa County (3.4%, OKR040019). The Coal Creek watershed has two small areas that are part of Tulsa County's MS4 responsibility (Figure 3-1b). The Ranch Creek watershed has City of Owasso and Tulsa County as its MS4 communities occupying a combined 32.5% of the area (Figure 3-1b).

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 significant sources of pollution, and may have the potential to 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 operate under NPDES permits issued and overseen by EPA. In order to comply with this TMDL, any 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 and ODAFF for follow-up. However, the Lower Bird Creek watershed has no permitted CAFO operations. Table 3-4 specifies that there are no CAFOs located in the Study Area.

**Table 3-4 NPDES-Permitted CAFOs in Study Area**

| ODAFF Owner ID | EPA Facility | 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 | | | |
| None | None | None | None | None | None | None | None | N/A | N/A |

## 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. For watersheds with no municipal wastewater NPDES facilities (total retention or discharging), nonsupport of PBCR use is caused only by nonpoint sources of bacteria. Watersheds with WWTPs that disinfect their effluents can be expected to not contribute significant bacteria in their discharge, but SSOs within collection systems could contribute. And non-disinfecting municipal WWTPs are expected to contribute bacteria in their effluent discharges as well as from possible SSOs. Therefore, total bacteria loads within a watershed from these latter two examples can be expected to come from a combination of nonpoint source and point source.

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 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. Deer harvest success varies from year to year based on weather and other factors; an estimated annual harvest rate of 20 percent to predict deer population by county was assumed. 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 the watershed.

**Table 3-5 Estimated Deer Populations**

| Waterbody ID | Waterbody Name | Deer | Acres |
|---|---|---|---|
| OK121300010010_00 | Bird Creek (Lower) | 903 | 114,924 |
| OK121300010090_00 | Coal Creek | 68 | 10,517 |
| OK121300010060_00 | Ranch Creek | 80 | 12,373 |

According to a study conducted by ASAE (the American Society of Agricultural Engineers), deer release approximately $5 \times 10^8$ 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 |
|---|---|---|---|---|---|
| OK121300010010_00 | Bird Creek (Lower) | 114,924 | 903 | 0.0079 | 4,515 |
| OK121300010090_00 | Coal Creek | 10,517 | 68 | 0.0065 | 340 |
| OK121300010060_00 | Ranch Creek | 12,373 | 80 | 0.006 | 400 |

### 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 deposit 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 in the Study Area based on U.S. Department of Agriculture (USDA) county agricultural census data (USDA 2002). These data were provided by ODEQ in spreadsheets. The estimated animal populations in Table 3-7 were derived by using the percentage of the watershed within each county. Because the watershed area in each county is generally much smaller than the county itself, 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 number of each type of animal per acre and total numbers of animal types within the watersheds are 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.

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

| ANIMAL CATEGORY | Bird Creek (Lower) | Coal Creek | Ranch Creek |
|---|---|---|---|
| **Cattle & Calves-all** | 8,262 | 589 | 704 |
| **Dairy Cows** | 68 | 2 | 3 |
| **Horses & Ponies** | 927 | 86 | 102 |
| **Goats** | 11 | 1 | 1 |
| **Sheep & Lambs** | 168 | 18 | 21 |
| **Hogs & Pigs** | 57 | 4 | 4 |
| **Ducks & Geese** | 207 | 19 | 23 |
| **Chickens & Turkeys** | 682 | 0 | 0 |
| **Acres of Manure Application** | 400 | 29 | 34 |

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

- 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, estimates of fecal coliform production from each group of commercially raised farm animals were calculated in Table 3-9 for each watershed in the Study Area. 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. The animal census data provided by ODAFF showed that there were no contract poultry growers in the Study Area (so indicated in Table 3-8). However, for consistency, estimated fecal coliform production for the general category of poultry based on USDA county agriculture census numbers is summarized in Table 3-9.

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

| Waterbody ID | Waterbody Name | County | Type | Estimated Birds |
|---|---|---|---|---|
| OK121300010010_00 | Bird Creek (Lower) | No growers | None | None |
| OK121300010090_00 | Coal Creek | No growers | None | None |
| OK121300010060_00 | Ranch Creek | No growers | None | None |

**Table 3-9 Fecal Coliform Production Estimates for Commercially Raised Farm Animals (x$10^9$ number/day)**

| ANIMAL CATEGORY | Bird Creek (Lower) | Coal Creek | Ranch Creek |
|---|---|---|---|
| **Cattle & Calves-all** | 859,206 | 62,235 | 73,213 |
| **Dairy Cows** | 6,874 | 245 | 288 |
| **Horses & Ponies** | 390 | 36.3 | 42.7 |
| **Sheep & Lambs** | 2,011 | 213 | 250 |
| **Hogs & Pigs** | 621 | 38.8 | 45.6 |
| **Ducks & Geese** | 503 | 46.9 | 55.1 |
| **Chickens & Turkeys** | 93 | 0 | 0 |
| **Total** | 1,382,916 | 62,815 | 73,895 |

### 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 can also discharge to creeks through springs and seeps.

To estimate the potential magnitude of OSWDs fecal bacteria loading, the number of OSWD systems was estimated for the Lower Bird Creek watershed. The estimate of OSWD systems was derived by using data from the 1990 U.S. Census (U.S. Census Bureau 2000) and provided by ODEQ to INCOG. The density of OSWD systems within the 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 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 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):

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

**Table 3-10 Estimates of Sewered and Unsewered Households**

| Waterbody ID | Waterbody Name | Public Sewer | Septic Tank | Other Means | Housing Units | % Sewered |
|---|---|---|---|---|---|---|
| OK121300010010_00 | Bird Creek (Lower) | 83,406 | 4,120 | 141 | 87,667 | 95.1% |
| OK121300010090_00 | Coal Creek | 15,430 | 216 | 7 | 15,653 | 98.6% |
| OK121300010060_00 | Ranch Creek | 1,047 | 441 | 0 | 1,515 | 70.9% |

The average of number of people per household was calculated to be 2.4 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 each of 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) |
|---|---|---|---|---|---|
| OK121300010010_00 | Bird Creek (Lower) | 114,924 | 4,120 | 494 | 0.6 |
| OK121300010090_00 | Coal Creek | 10,517 | 216 | 26 | 0.03 |
| OK121300010060_00 | Ranch Creek | 12,373 | 441 | 53 | 0.06 |

### 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 1.7 dogs per household and 2.2 cats per household (American Veterinary Medical Association 2007). 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 Study Area.

**Table 3-12 Estimated Numbers of Pets**

| Waterbody ID | Waterbody Name | Dogs | Cats |
|---|---|---|---|
| OK121300010010_00 | Bird Creek (Lower) | 367,197 | 475,197 |
| OK121300010090_00 | Coal Creek | 58,017 | 75,080 |
| OK121300010060_00 | Ranch Creek | 8,758 | 11,333 |

Table 3-13 provides an estimate of the fecal coliform load from pets. These estimates are based on estimated fecal coliform production rates of $5.4 \times 10^8$ per day for cats and $3.3 \times 10^9$ 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 |
|---|---|---|---|---|
| OK121300010010_00 | Bird Creek (Lower) | 1,211,750 | 256,606 | 1,468,357 |
| OK121300010090_00 | Coal Creek | 191,456 | 40,543 | 231,999 |
| OK121300010060_00 | Ranch Creek | 28,901 | 6,120 | 35,021 |

## 3.3 Summary of Bacteria Sources

Table 3-14 summarizes the suspected sources of bacteria loading in each impaired watershed. There are three municipal WWTP NPDES-permitted discharge facilities present in the watershed, and all three presently disinfect their effluent. Therefore, nonsupport of the PBCR use is likely caused mainly by nonpoint sources or other point sources. For example, it can be expected that the large MS4 areas in the watersheds result in MS4 point source loadings.

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

| Waterbody ID | Waterbody Name | Point Sources | Nonpoint Sources | Major Source |
|---|---|---|---|---|
| OK121300010010_00 | Bird Creek (Lower) | Yes | Yes | Nonpoint/point |
| OK121300010090_00 | Coal Creek | No | Yes | Nonpoint/point |
| OK121300010060_00 | Ranch Creek | No | Yes | Nonpoint/point |

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. In the entire Lower Bird Creek watershed, pets and commercially raised farm animals are estimated to be the primary contributors of fecal coliform loading to land surfaces with pets being slightly more significant. In the urban landuses dominated Coal Creek watershed, pets are the primary sources while in the much less urbanized Ranch Creek watershed, commercially raised farm animals contribute the most.

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. If fecal coliform loads from other wildlife could be included in Table 3-15, the percent loads of the two largest nonpoint estimates (farm animals and pets) would be lower proportional to the amount of loads that would be calculated for wildlife.

The magnitude of loading to a stream may not be reflected in 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.

If poultry litter is applied to areas in the watershed 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 Nonpoint Sources to Land Surfaces**

| Waterbody ID | Waterbody Name | Commercially Raised Farm Animals | Pets | Deer | Estimated Loads from Septic Tanks |
|---|---|---|---|---|---|
| OK121300010010_00 | Bird Creek (Lower) | 48.5% | 51.5% | 0.0% | 0.0% |
| OK121300010090_00 | Coal Creek | 21.3% | 78.7% | 0.0% | 0.0% |
| OK121300010060_00 | Ranch Creek | 67.8% | 32.1% | 0.0% | 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 WQS 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 (FDCs) 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. A more complex approach 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 (x-axis), 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 Lower Bird Creek 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.

## 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 WQS 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 WQS 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: Define 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 WQS 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. This LDC 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, NPDES permit limits are used to derive WLAs. The permitted average flow rate used for each point source discharge and the water quality criterion concentration defined in the permit are used to estimate the WLA for each wastewater facility. In cases where a permitted flow rate is not available for a WWTP, then the average of monthly flow rates derived from DMRs can be used. WLA values from all NPDES wastewater dischargers are then summed to represent the total WLA for the watershed. Using this information bacteria WLAs can be calculated using a mass balance approach as shown in the equation below.

*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-$10^6$gal/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 cases 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 Flow Duration Curves

Following the same procedures described in Section 4.3, Figures 4-1 to 4-3 are the flow duration curves developed for the studied stream segments. The flow duration curve for the Lower Bird Creek (OK121200010010_00) was based on measured flows at USGS gage station 07178200 (Bird Creek near Catoosa, OK). This gage is co-located with WQM station OK121300010010-001AT. The flow period used for this station was January 1, 1990 through August 16, 2009. This is the period of record represented by the current dam impoundments in the Bird Creek watershed.

The flow duration curve for the Coal Creek (OK121300010090_00) was based on measured flows at USGS gage station 07177800 (Coal Creek at Tulsa, OK). The gage is co-located with OCC WQM station OK121300-01-0090M. The flow period used for this station was January 30, 1988 through September 30, 2009.

No flow gage exists on Ranch Creek (OK121300010060_00). Therefore, flows for this waterbody were projected using the watershed area ratio method based on measured flows at USGS gage station 07177800 (Coal Creek at Tulsa, OK). The flow period used for this station was January 30, 1988 through September 30, 2009.

**Figure 5-1**

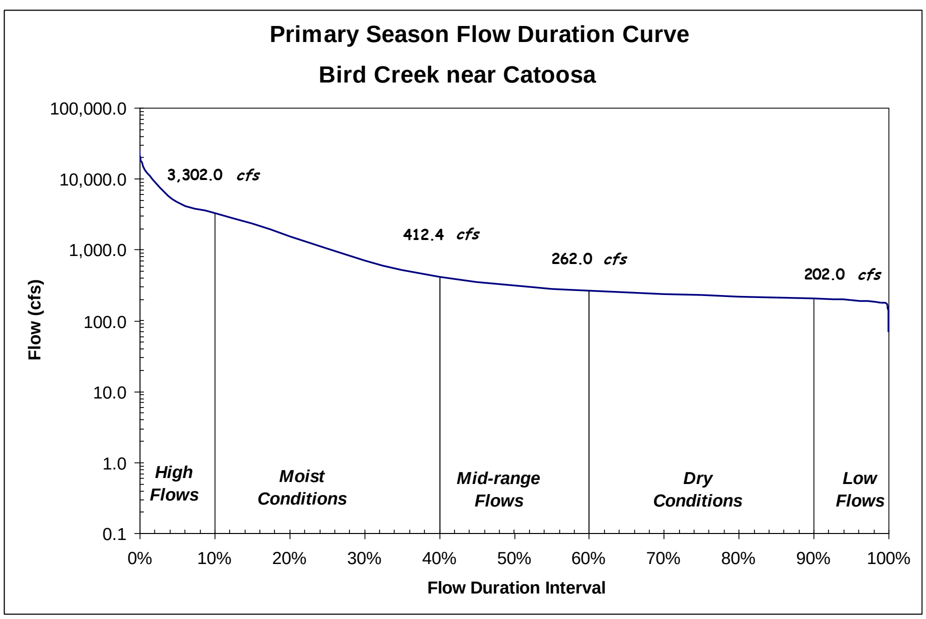


**Figure 5-2**

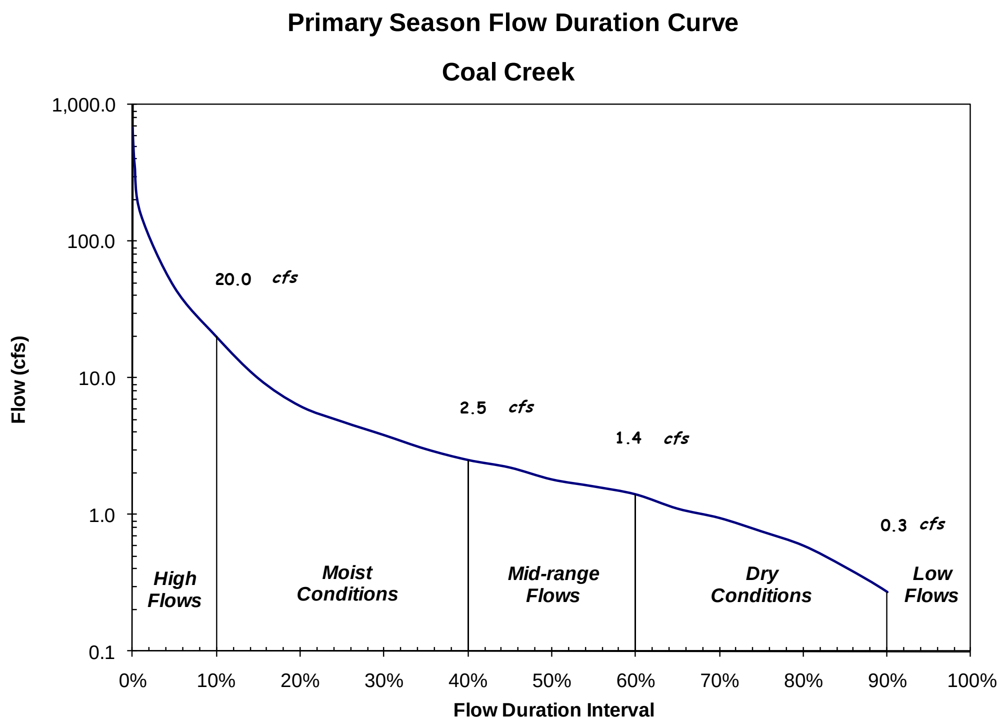
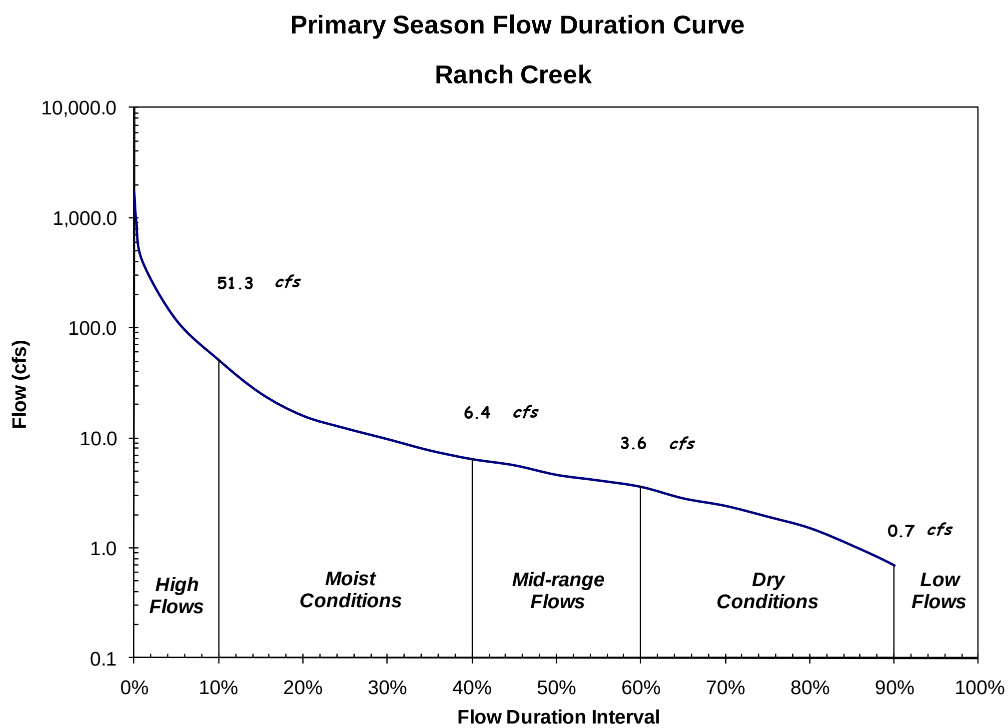



**Figure 5-3**



## 5.2 Estimated Loading and Critical Conditions

**Load Duration Curves:** 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) 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 or projected 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.

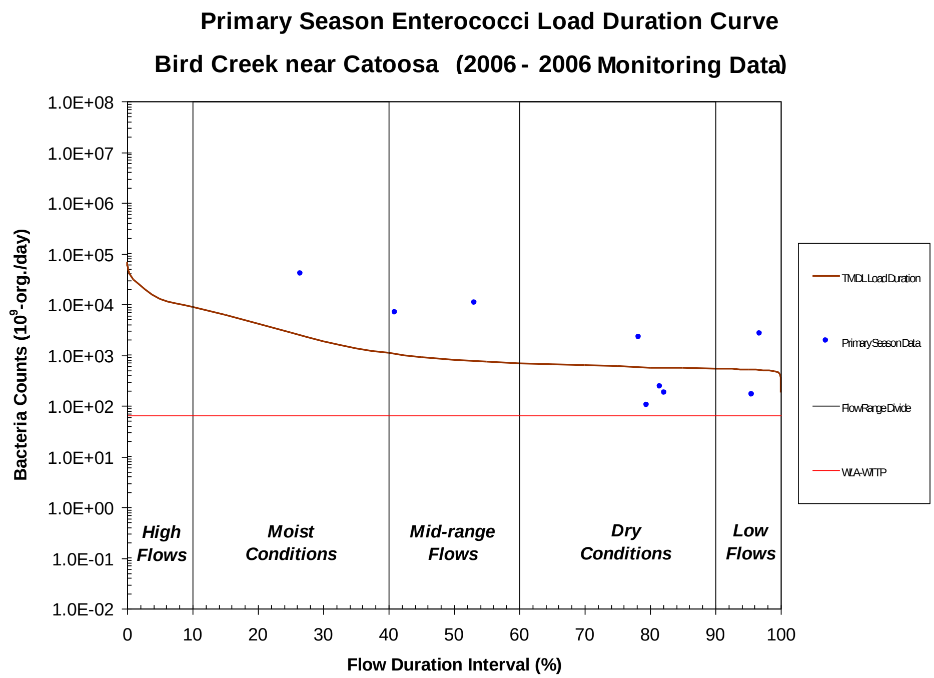
A subset of the LDCs for each impaired waterbody is shown in Figures 5-4 through 5-6. While some waterbodies may be listed for multiple bacterial indicators, only one LDC for each waterbody is presented in Figures 5-4 through 5-6 – the LDC for the bacterial indicator that has the largest PRG (Table 5-1). The LDCs for the other bacterial indicators that require TMDLs are presented in Subsection 5.7 of this report.

The LDC for Lower Bird Creek segment OK121300010010_00 (Figure 5-4) is based on Enterococcus bacteria measurements during the primary contact recreation season at WQM station OK121300010010-001AT. The LDC indicates that Enterococcus levels exceed the instantaneous water quality criteria during all flow conditions except high flows. Exceedances during non-dry 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 Coal Creek (OK121300010090_00, Figure 5-5) is based on *E. Coli* bacteria measurements during the primary contact recreation season at WQM station OK121300-01-0090M. The LDC indicates that *E. Coli* levels exceed the instantaneous water quality criteria during mid-flow to moist conditions. Exceedances during non-dry conditions are thought to be due to non-point sources.

The LDC for Ranch Creek (OK121300010060_00, Figure 5-6) is based on *E. Coli* bacteria measurements during the primary contact recreation season at WQM station OK121300-01-0060G. The LDC indicates that *E. Coli* levels exceed the instantaneous water quality criteria during mid-flow to moist conditions. Exceedances during non-dry conditions are thought to be due to non-point sources.

# Figure 5-4




# Figure 5-5

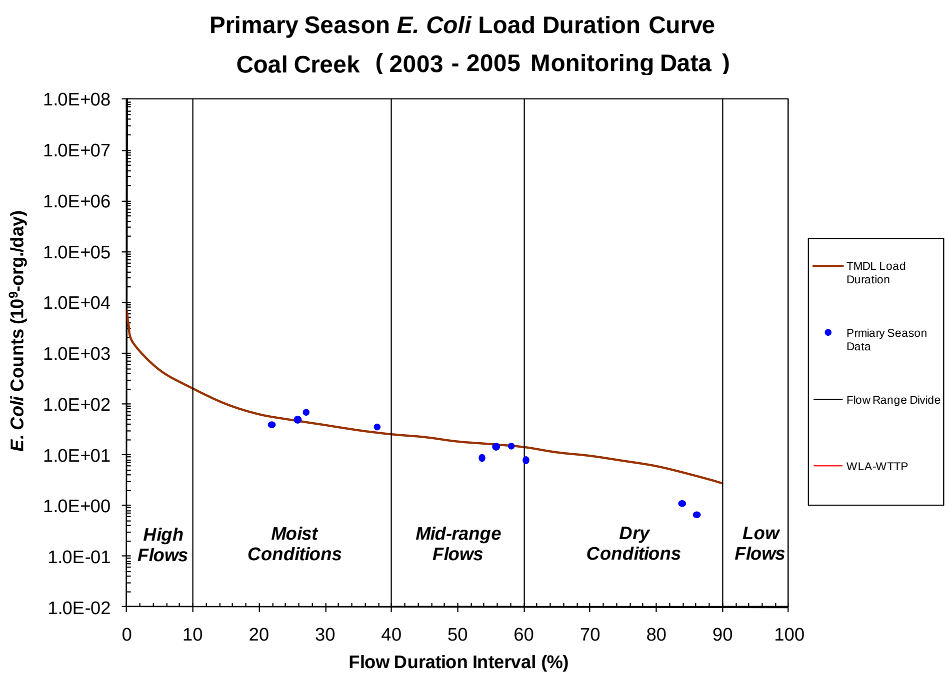
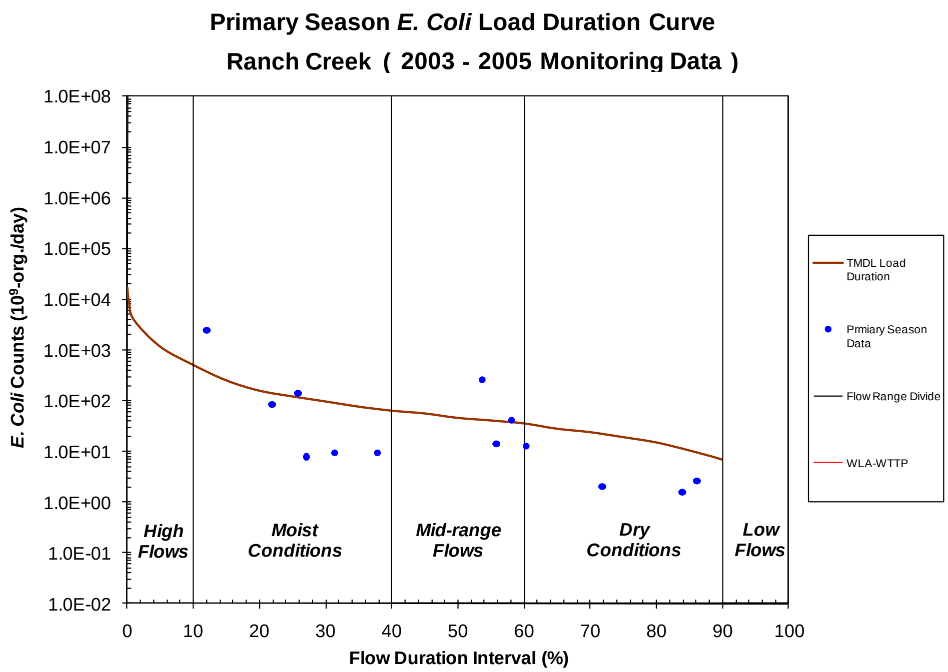


**Figure 5-6**




**Establishing Percent Reduction Goals:** 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 (PRGs) 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 the waterbodies in the Study Area. Attainment of WQS in response to TMDL implementation will be based on future results measured within the stream segment. The appropriate PRG for each bacteria indicator for each waterbody in Table 5-1 is denoted by the bold text. The PRGs range from 44.8 to 82.6 percent. Because the Coal and Ranch Creeks are tributaries to the Lower Bird Creek and the load reduction goals for the Coal and Ranch Creeks are either equal or smaller than that for the Lower Bird Creek for *E. Coli*, the more restrictive load reduction goal of 44.8% for the Lower Bird Creek will apply to these two tributaries.

**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 | |
| | | | Instant-aneous | Instant-aneous | Geo-mean | Instant-aneous | Geo-mean |
| OK121300010010-001AT | OK121300010010_00 | Bird Creek (Lower) | **64.1%** | 79.1% | **44.8%** | 94.4% | **82.6%** |
| OK121300-01-0090M | OK121300010090_00 | Coal Creek | | **44.8%†** | 58.6% | | |
| OK121300-01-0060G | OK121300010060_00 | Ranch Creek | | 85.3% | **32.8%†** | | |

† Because these two values are either equal or smaller than that for the Lower Bird Creek for *E. Coli*, the more restrictive load reduction goal of 44.8% for the Lower Bird Creek will apply to these two tributaries.

## 5.3 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-$10^6$gal/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 | Name | NPDES Permit No. | Design Flow (mgd) | Disin-fection | Wasteload Allocation (cfu/day) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Fecal Coliform | *E. Coli* | Enterococci |
| OK121300010010_00 | Owasso | OK0020303 | 3.3 | Yes | 2.50E+10 | 1.57E+10 | 4.12E+09 |
| OK121300010010_00 | Lower Bird Creek Regional | OK0042935 | 5.41 | Yes | 4.10E+10 | 2.58E+10 | 6.76E+09 |
| OK121300010010_00 | Tulsa Northside | OK0026221 | 42.6 | Yes | 3.23E+11 | 2.03E+11 | 5.32E+10 |

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. There are five urbanized areas designated as permitted MS4s that have a portion of their MS4s within the Lower Bird Creek watershed: the City of Tulsa (Phase I at 51.8% of the watershed), Owasso (7.8% of the watershed), Catoosa (2.5%), Broken Arrow (0.7%) and Tulsa County (3.4%, and the latter four all being Phase II permittees). The flow dependent calculations for the WLA established for the MS4s are provided in Table 5-3. The Coal Creek watershed has 100% of its area within MS4s (City of Tulsa and two small areas that are part of Tulsa County's MS4 responsibility). The Ranch Creek watershed has City of Owasso and Tulsa County as its MS4 communities occupying a combined 32.5% of the area.

## 5.4 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

## 5.5 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 the longest period of USGS flow records when estimating flows to develop flow exceedance percentiles.

## 5.6 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 WQS 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. An explicit MOS of 10 percent was selected for TMDLs in this report.

## 5.7 TMDL Calculations

The bacteria TMDLs for the 303(d)-listed stream segment 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:

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

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 5-6). 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 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 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 LA (nonpoint sources). 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**

| 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) |
|---|---|---|---|---|---|---|---|---|
| OK121300010010_00 | OK121300010010_001AT | Bird Creek (Lower) | ENT | 8.11E+11 | 6.41E+10 | 4.41E+11 | 2.25E+11 | 8.11E+10 |
| OK121300010090_00 | OK121300-01-0090M | Coal Creek | EC | 1.79E+10 | 0.00E+00 | 1.61E+10 | 0.00E+00 | 1.79E+09 |
| OK121300010060_00 | OK121300-01-0060G | Ranch Creek | EC | 4.59E+10 | 0.00E+00 | 1.34E+10 | 2.79E+10 | 4.59E+09 |

† Derived for illustrative purposes at the median flow value

**Table 5-4 Enterococci TMDL Calculations for Lower Bird Creek (OK121300010010_00)**

| Percentile | Flow (cfs) | TMDL (cfu/day) | WLA_WWTP (cfu/day) | WLA_MS4s (cfu/day) | LA (cfu/day) | MOS (cfu/day) |
|---|---|---|---|---|---|---|
| 0 | 25,900.0 | 6.84E+13 | 6.41E+10 | 4.07E+13 | 2.08E+13 | 6.84E+12 |
| 5 | 4,763.0 | 1.26E+13 | 6.41E+10 | 7.45E+12 | 3.81E+12 | 1.26E+12 |
| 10 | 3,302.0 | 8.72E+12 | 6.41E+10 | 5.16E+12 | 2.63E+12 | 8.72E+11 |
| 15 | 2,360.0 | 6.24E+12 | 6.41E+10 | 3.67E+12 | 1.88E+12 | 6.24E+11 |
| 20 | 1,552.0 | 4.10E+12 | 6.41E+10 | 2.40E+12 | 1.23E+12 | 4.10E+11 |
| 25 | 1,045.0 | 2.76E+12 | 6.41E+10 | 1.60E+12 | 8.18E+11 | 2.76E+11 |
| 30 | 704.0 | 1.86E+12 | 6.41E+10 | 1.07E+12 | 5.44E+11 | 1.86E+11 |
| 35 | 511.1 | 1.35E+12 | 6.41E+10 | 7.62E+11 | 3.89E+11 | 1.35E+11 |
| 40 | 412.4 | 1.09E+12 | 6.41E+10 | 6.07E+11 | 3.10E+11 | 1.09E+11 |
| 45 | 345.7 | 9.13E+11 | 6.41E+10 | 5.02E+11 | 2.56E+11 | 9.13E+10 |
| 50 | 307.0 | 8.11E+11 | 6.41E+10 | 4.41E+11 | 2.25E+11 | 8.11E+10 |
| 55 | 281.3 | 7.43E+11 | 6.41E+10 | 4.00E+11 | 2.04E+11 | 7.43E+10 |
| 60 | 262.0 | 6.92E+11 | 6.41E+10 | 3.70E+11 | 1.89E+11 | 6.92E+10 |
| 65 | 247.0 | 6.53E+11 | 6.41E+10 | 3.46E+11 | 1.77E+11 | 6.53E+10 |
| 70 | 235.2 | 6.21E+11 | 6.41E+10 | 3.28E+11 | 1.67E+11 | 6.21E+10 |
| 75 | 226.0 | 5.97E+11 | 6.41E+10 | 3.13E+11 | 1.60E+11 | 5.97E+10 |
| 80 | 216.00 | 5.71E+11 | 6.41E+10 | 2.98E+11 | 1.52E+11 | 5.71E+10 |
| 85 | 209.00 | 5.52E+11 | 6.41E+10 | 2.87E+11 | 1.46E+11 | 5.52E+10 |
| 90 | 202.00 | 5.34E+11 | 6.41E+10 | 2.76E+11 | 1.41E+11 | 5.34E+10 |
| 95 | 193.00 | 5.10E+11 | 6.41E+10 | 2.61E+11 | 1.33E+11 | 5.10E+10 |
| 100 | 69.00 | 1.82E+11 | 6.41E+10 | 6.62E+10 | 3.38E+10 | 1.82E+10 |

### Table 5-5 *E. Coli* TMDL Calculations for Coal Creek (OK121300010090_00)

| Percentile | Flow (cfs) | TMDL (cfu/day) | WLA_WWTP (cfu/day) | WLA_MS4s (cfu/day) | LA (cfu/day) | MOS (cfu/day) |
|---|---|---|---|---|---|---|
| 0 | 675.0 | 6.70E+12 | 0.00E+00 | 6.03E+12 | 0.00E+00 | 6.70E+11 |
| 5 | 46.0 | 4.57E+11 | 0.00E+00 | 4.11E+11 | 0.00E+00 | 4.57E+10 |
| 10 | 20.0 | 1.99E+11 | 0.00E+00 | 1.79E+11 | 0.00E+00 | 1.99E+10 |
| 15 | 9.9 | 9.83E+10 | 0.00E+00 | 8.85E+10 | 0.00E+00 | 9.83E+09 |
| 20 | 6.2 | 6.16E+10 | 0.00E+00 | 5.54E+10 | 0.00E+00 | 6.16E+09 |
| 25 | 4.8 | 4.74E+10 | 0.00E+00 | 4.27E+10 | 0.00E+00 | 4.74E+09 |
| 30 | 3.8 | 3.77E+10 | 0.00E+00 | 3.40E+10 | 0.00E+00 | 3.77E+09 |
| 35 | 3.0 | 2.98E+10 | 0.00E+00 | 2.68E+10 | 0.00E+00 | 2.98E+09 |
| 40 | 2.5 | 2.48E+10 | 0.00E+00 | 2.23E+10 | 0.00E+00 | 2.48E+09 |
| 45 | 2.2 | 2.19E+10 | 0.00E+00 | 1.97E+10 | 0.00E+00 | 2.19E+09 |
| 50 | 1.8 | 1.79E+10 | 0.00E+00 | 1.61E+10 | 0.00E+00 | 1.79E+09 |
| 55 | 1.6 | 1.59E+10 | 0.00E+00 | 1.43E+10 | 0.00E+00 | 1.59E+09 |
| 60 | 1.4 | 1.39E+10 | 0.00E+00 | 1.25E+10 | 0.00E+00 | 1.39E+09 |
| 65 | 1.1 | 1.09E+10 | 0.00E+00 | 9.83E+09 | 0.00E+00 | 1.09E+09 |
| 70 | 0.9 | 9.34E+09 | 0.00E+00 | 8.40E+09 | 0.00E+00 | 9.34E+08 |
| 75 | 0.8 | 7.45E+09 | 0.00E+00 | 6.70E+09 | 0.00E+00 | 7.45E+08 |
| 80 | 0.59 | 5.86E+09 | 0.00E+00 | 5.27E+09 | 0.00E+00 | 5.86E+08 |
| 85 | 0.41 | 4.07E+09 | 0.00E+00 | 3.66E+09 | 0.00E+00 | 4.07E+08 |
| 90 | 0.27 | 2.68E+09 | 0.00E+00 | 2.41E+09 | 0.00E+00 | 2.68E+08 |
| 95 | 0.16 | 1.59E+09 | 0.00E+00 | 1.43E+09 | 0.00E+00 | 1.59E+08 |
| 100 | 0.00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |

**Table 5-6 *E. Coli* TMDL Calculations for Ranch Creek (OK121300010060_00)**

| Percentile | Flow (cfs) | TMDL (cfu/day) | WLA_WWTP (cfu/day) | WLA_MS4s (cfu/day) | LA (cfu/day) | MOS (cfu/day) |
|---|---|---|---|---|---|---|
| 0 | 1,733.0 | 1.72E+13 | 0.00E+00 | 5.03E+12 | 1.05E+13 | 1.72E+12 |
| 5 | 118.1 | 1.17E+12 | 0.00E+00 | 3.43E+11 | 7.13E+11 | 1.17E+11 |
| 10 | 51.3 | 5.10E+11 | 0.00E+00 | 1.49E+11 | 3.10E+11 | 5.10E+10 |
| 15 | 25.4 | 2.52E+11 | 0.00E+00 | 7.38E+10 | 1.53E+11 | 2.52E+10 |
| 20 | 15.9 | 1.58E+11 | 0.00E+00 | 4.62E+10 | 9.61E+10 | 1.58E+10 |
| 25 | 12.3 | 1.22E+11 | 0.00E+00 | 3.56E+10 | 7.40E+10 | 1.22E+10 |
| 30 | 9.8 | 9.69E+10 | 0.00E+00 | 2.83E+10 | 5.89E+10 | 9.69E+09 |
| 35 | 7.7 | 7.65E+10 | 0.00E+00 | 2.24E+10 | 4.65E+10 | 7.65E+09 |
| 40 | 6.4 | 6.37E+10 | 0.00E+00 | 1.86E+10 | 3.87E+10 | 6.37E+09 |
| 45 | 5.6 | 5.61E+10 | 0.00E+00 | 1.64E+10 | 3.41E+10 | 5.61E+09 |
| 50 | 4.6 | 4.59E+10 | 0.00E+00 | 1.34E+10 | 2.79E+10 | 4.59E+09 |
| 55 | 4.1 | 4.08E+10 | 0.00E+00 | 1.19E+10 | 2.48E+10 | 4.08E+09 |
| 60 | 3.6 | 3.57E+10 | 0.00E+00 | 1.04E+10 | 2.17E+10 | 3.57E+09 |
| 65 | 2.8 | 2.80E+10 | 0.00E+00 | 8.20E+09 | 1.70E+10 | 2.80E+09 |
| 70 | 2.4 | 2.40E+10 | 0.00E+00 | 7.00E+09 | 1.46E+10 | 2.40E+09 |
| 75 | 1.9 | 1.91E+10 | 0.00E+00 | 5.59E+09 | 1.16E+10 | 1.91E+09 |
| 80 | 1.51 | 1.50E+10 | 0.00E+00 | 4.40E+09 | 9.14E+09 | 1.50E+09 |
| 85 | 1.05 | 1.05E+10 | 0.00E+00 | 3.06E+09 | 6.35E+09 | 1.05E+09 |
| 90 | 0.69 | 6.88E+09 | 0.00E+00 | 2.01E+09 | 4.18E+09 | 6.88E+08 |
| 95 | 0.41 | 4.08E+09 | 0.00E+00 | 1.19E+09 | 2.48E+09 | 4.08E+08 |
| 100 | 0.00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 | 0.00E+00 |

## 5.8 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 the additional bacterial indicators are shown in Figures 5-4 through 5-5 and Tables 5-7 through 5-8, respectively.

**Figure 5-7 Primary Season Fecal Coliform Load Duration Curve for Lower Bird Creek**

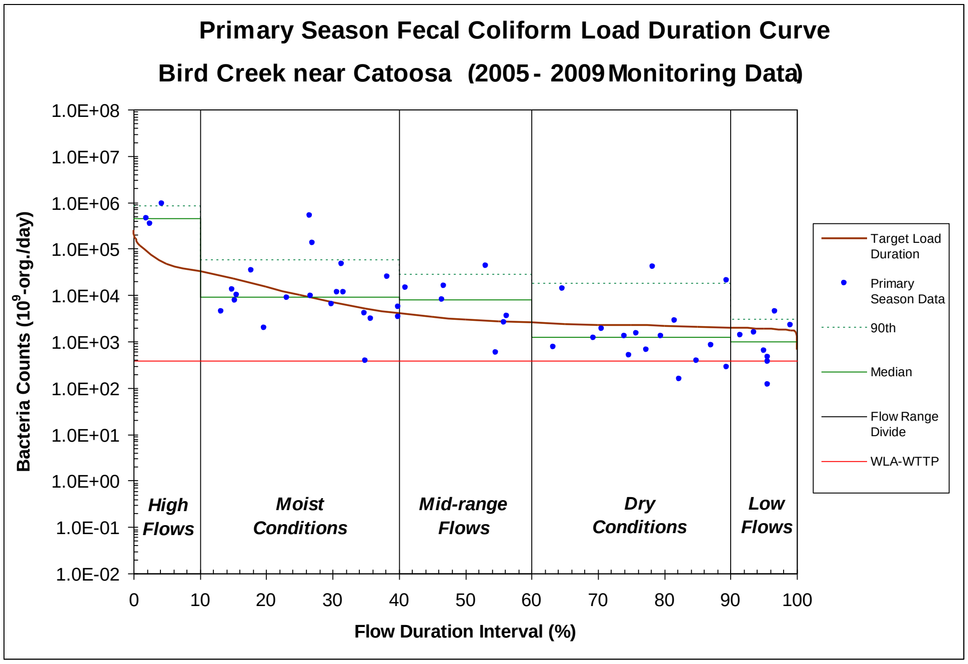



**Table 5-7 Fecal Coliform TMDL Calculations for Lower Bird Creek**

| Percentile | Flow (cfs) | TMDL (cfu/day) | WLA_WWTP (cfu/day) | WLA_MS4s (cfu/day) | LA (cfu/day) | MOS (cfu/day) |
|---|---|---|---|---|---|---|
| 0 | 25,900.0 | 2.53E+14 | 3.88E+11 | 1.51E+14 | 7.70E+13 | 2.53E+13 |
| 5 | 4,763.0 | 4.66E+13 | 3.88E+11 | 2.75E+13 | 1.40E+13 | 4.66E+12 |
| 10 | 3,302.0 | 3.23E+13 | 3.88E+11 | 1.90E+13 | 9.70E+12 | 3.23E+12 |
| 15 | 2,360.0 | 2.31E+13 | 3.88E+11 | 1.35E+13 | 6.89E+12 | 2.31E+12 |
| 20 | 1,552.0 | 1.52E+13 | 3.88E+11 | 8.79E+12 | 4.49E+12 | 1.52E+12 |
| 25 | 1,045.0 | 1.02E+13 | 3.88E+11 | 5.84E+12 | 2.98E+12 | 1.02E+12 |
| 30 | 704.0 | 6.89E+12 | 3.88E+11 | 3.85E+12 | 1.96E+12 | 6.89E+11 |
| 35 | 511.1 | 5.00E+12 | 3.88E+11 | 2.72E+12 | 1.39E+12 | 5.00E+11 |
| 40 | 412.4 | 4.04E+12 | 3.88E+11 | 2.15E+12 | 1.10E+12 | 4.04E+11 |
| 45 | 345.7 | 3.38E+12 | 3.88E+11 | 1.76E+12 | 8.98E+11 | 3.38E+11 |
| 50 | 307.0 | 3.00E+12 | 3.88E+11 | 1.53E+12 | 7.83E+11 | 3.00E+11 |
| 55 | 281.3 | 2.75E+12 | 3.88E+11 | 1.38E+12 | 7.06E+11 | 2.75E+11 |
| 60 | 262.0 | 2.56E+12 | 3.88E+11 | 1.27E+12 | 6.49E+11 | 2.56E+11 |
| 65 | 247.0 | 2.42E+12 | 3.88E+11 | 1.18E+12 | 6.04E+11 | 2.42E+11 |
| 70 | 235.2 | 2.30E+12 | 3.88E+11 | 1.11E+12 | 5.69E+11 | 2.30E+11 |
| 75 | 226.0 | 2.21E+12 | 3.88E+11 | 1.06E+12 | 5.41E+11 | 2.21E+11 |
| 80 | 216.00 | 2.11E+12 | 3.88E+11 | 1.00E+12 | 5.12E+11 | 2.11E+11 |
| 85 | 209.00 | 2.05E+12 | 3.88E+11 | 9.61E+11 | 4.91E+11 | 2.05E+11 |
| 90 | 202.00 | 1.98E+12 | 3.88E+11 | 9.20E+11 | 4.70E+11 | 1.98E+11 |
| 95 | 193.00 | 1.89E+12 | 3.88E+11 | 8.68E+11 | 4.43E+11 | 1.89E+11 |
| 100 | 69.00 | 6.75E+11 | 3.88E+11 | 1.45E+11 | 7.41E+10 | 6.75E+10 |

**Figure 5-8 Primary Season *E. coli* Load Duration Curve for Lower Bird Creek**

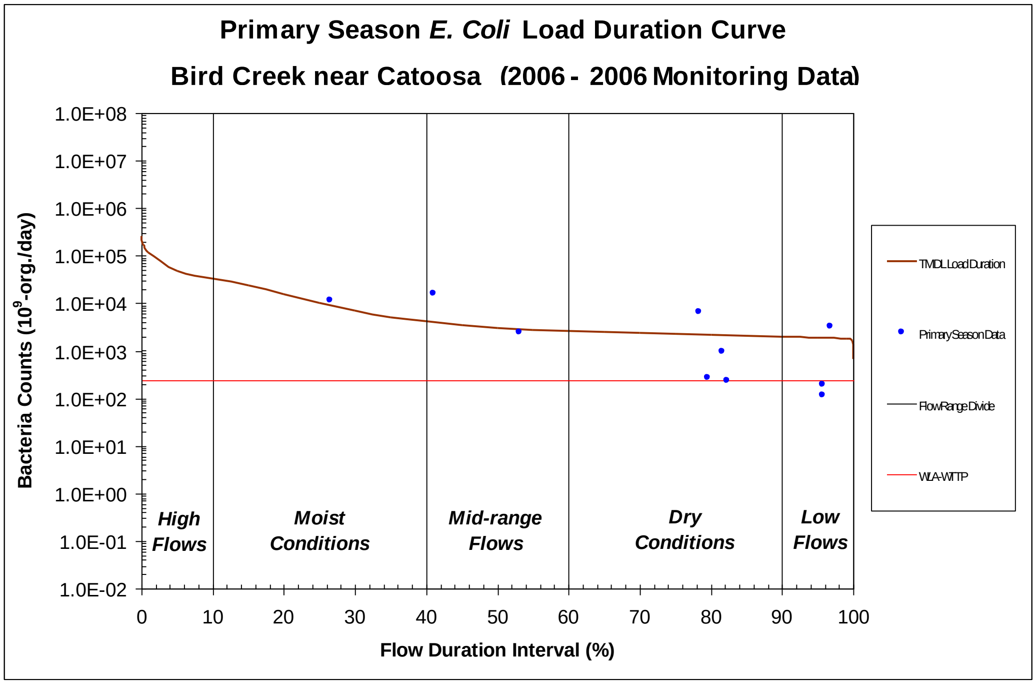



**Table 5-8 *E. Coli* TMDL Calculations for Lower Bird Creek**

| Percentile | Flow (cfs) | TMDL (cfu/day) | WLA_WWTP (cfu/day) | WLA_MS4s (cfu/day) | LA (cfu/day) | MOS (cfu/day) |
|---|---|---|---|---|---|---|
| 0 | 25,900.0 | 2.57E+14 | 2.45E+11 | 1.53E+14 | 7.82E+13 | 2.57E+13 |
| 5 | 4,763.0 | 4.73E+13 | 2.45E+11 | 2.80E+13 | 1.43E+13 | 4.73E+12 |
| 10 | 3,302.0 | 3.28E+13 | 2.45E+11 | 1.94E+13 | 9.89E+12 | 3.28E+12 |
| 15 | 2,360.0 | 2.34E+13 | 2.45E+11 | 1.38E+13 | 7.05E+12 | 2.34E+12 |
| 20 | 1,552.0 | 1.54E+13 | 2.45E+11 | 9.02E+12 | 4.61E+12 | 1.54E+12 |
| 25 | 1,045.0 | 1.04E+13 | 2.45E+11 | 6.02E+12 | 3.07E+12 | 1.04E+12 |
| 30 | 704.0 | 6.99E+12 | 2.45E+11 | 4.00E+12 | 2.04E+12 | 6.99E+11 |
| 35 | 511.1 | 5.08E+12 | 2.45E+11 | 2.86E+12 | 1.46E+12 | 5.08E+11 |
| 40 | 412.4 | 4.10E+12 | 2.45E+11 | 2.28E+12 | 1.16E+12 | 4.10E+11 |
| 45 | 345.7 | 3.43E+12 | 2.45E+11 | 1.88E+12 | 9.62E+11 | 3.43E+11 |
| 50 | 307.0 | 3.05E+12 | 2.45E+11 | 1.65E+12 | 8.45E+11 | 3.05E+11 |
| 55 | 281.3 | 2.79E+12 | 2.45E+11 | 1.50E+12 | 7.67E+11 | 2.79E+11 |
| 60 | 262.0 | 2.60E+12 | 2.45E+11 | 1.39E+12 | 7.09E+11 | 2.60E+11 |
| 65 | 247.0 | 2.45E+12 | 2.45E+11 | 1.30E+12 | 6.64E+11 | 2.45E+11 |
| 70 | 235.2 | 2.34E+12 | 2.45E+11 | 1.23E+12 | 6.28E+11 | 2.34E+11 |
| 75 | 226.0 | 2.24E+12 | 2.45E+11 | 1.18E+12 | 6.00E+11 | 2.24E+11 |
| 80 | 216.00 | 2.15E+12 | 2.45E+11 | 1.12E+12 | 5.70E+11 | 2.15E+11 |
| 85 | 209.00 | 2.08E+12 | 2.45E+11 | 1.07E+12 | 5.49E+11 | 2.08E+11 |
| 90 | 202.00 | 2.01E+12 | 2.45E+11 | 1.03E+12 | 5.28E+11 | 2.01E+11 |
| 95 | 193.00 | 1.92E+12 | 2.45E+11 | 9.80E+11 | 5.00E+11 | 1.92E+11 |
| 100 | 69.00 | 6.85E+11 | 2.45E+11 | 2.46E+11 | 1.26E+11 | 6.85E+10 |

## 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 5-9 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 5-9 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/ |
| Oklahoma Water Resources Board | http://www.owrb.ok.gov/quality/index.php |

The Oklahoma Conservation Commission is the lead agency for Nonpoint Source Pollution in Oklahoma. The OCC works with state partners such as ODAFF and federal partners such EPA and NRCS, to address water quality problems similar to those seen in the North Canadian watershed. 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.

When a watershed extends into an adjacent state, the same reduction goal that applies to the watershed within Oklahoma should also be considered to apply to the watershed in the adjacent state. These goals could be achieved by reductions in some combination of nonpoint sources and uncontrolled point sources. Since Oklahoma has no authority over potential bacteria sources in adjacent states, these reductions can only be facilitated through cooperation between Oklahoma agencies, the adjacent state and EPA.

Discharges from wastewater treatment facilities in the watershed will have to meet the bacterial standards as required in the OPDES permit. Stormwater discharges are also considered as point sources. Requirements for the regulated MS4s are set forth in their stormwater permits. A selection of BMPs may be implemented to reduce bacteria load from stormwater. The stormwater permit holders are not required by the TMDL to achieve the total load reduction to restore water quality standards. Instead, they are responsible only for their own contributions.

The reduction rates called for in this TMDL report are as high as 82.6 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 WQS 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. This approach might not be successful since there are portions of this segment where people could have primary body contact during the recreation season, 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 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 report received EPA technical review acceptance on August 5, 2010. A public notice was circulated on May 15, 2011 to local newspapers and/or other publications in the area affected by this TMDL and persons on the DEQ contact list. The public comment period ended on June 30, 2011. No requests for a public meeting were received. Comments from the U.S. EPA, the Oklahoma Conservation Commission, and the Natchez Nation were received. The responses to comments are included in Appendix F as part of this TMDL report.

After EPA's final approval, each TMDL will be adopted into the Water Quality Management Plan (WQMP). These TMDLs provide a mathematical solution to meet ambient water quality criterion with a given set of facts. The adoption of these TMDLs into the WQMP provides a mechanism to recalculate acceptable loads when information changes in the future. Updates to the WQMP demonstrate compliance with the water quality criterion. The updates to the WQMP are also useful when the water quality criterion changes and the loading scenario is reviewed to ensure that the in-stream criterion is predicted to be met.

# SECTION 7
# REFERENCES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# APPENDIX A
# AMBIENT WATER QUALITY BACTERIA DATA – 2003 TO 2009

# Appendix A

## 1. Bird Creek (Lower, OK121300010010_00) Ambient Water Quality Bacteria Data

| Combined Dates COT & OWRB | FC measured or avg. | Notes on source of FC data |
|---|---|---|
| 5/2/2005 | 168 | COT only |
| 5/16/2005 | 270 | COT only |
| 6/1/2005 | 380 | COT only |
| 6/15/2005 | 5,900 | COT only |
| 7/6/2005 | 780 | COT only |
| 7/20/2005 | 56 | COT only |
| 8/3/2005 | 75 | COT only |
| 8/17/2005 | 1,950 | COT only |
| 9/1/2005 | 208 | COT only |
| 9/19/2005 | 520 | COT only |
| 5/8/2006 | 433 | COT only |
| 5/22/2006 | 320 | COT only |
| 05/23/2006 | 25 | OWRB only |
| 6/7/2006 | 2,300 | COT only |
| 06/12/2006 | 955 | OWRB only |
| 6/21/2006 | 4,200 | COT only |
| 06/26/2006 | 535 | OWRB only |
| 07/05/2006 | 80 | OWRB only |
| 7/6/2006 | 520 | COT only |
| 7/21/2006 | 91 | COT only |
| 07/24/2006 | 30 | OWRB only |
| 08/07/2006 | 253 | COT/OWRB avg. |
| 08/21/2006 | 22,700 | COT/OWRB avg. |
| 08/22/2006 | 1,470 | OWRB only |
| 09/05/2006 | 7,750 | OWRB only |
| 9/7/2006 | 100 | COT only |
| 09/18/2006 | 6,150 | OWRB only |
| 9/21/2006 | 279 | COT only |
| 5/2/2007 | 7,100 | COT only |
| 5/16/2007 | 290 | COT only |
| 6/4/2007 | 370 | COT only |
| 6/18/2007 | 181 | COT only |
| 7/2/2007 | 2,100 | COT only |
| 7/16/2007 | 3,000 | COT only |
| 8/1/2007 | 133 | COT only |
| 8/15/2007 | 31 | COT only |
| 9/5/2007 | 320 | COT only |
| 9/19/2007 | 240 | COT only |

| | | |
|---|---|---|
| 5/5/2008 | 255 | COT only |
| 5/19/2008 | 50 | COT only |
| 6/4/2008 | 750 | COT only |
| 6/18/2008 | 1,800 | COT only |
| 7/8/2008 | 69 | COT only |
| 7/22/2008 | 82 | COT only |
| 8/5/2008 | 124 | COT only |
| 8/19/2008 | 120 | COT only |
| 9/2/2008 | 330 | COT only |
| 9/16/2008 | 700 | COT only |
| 5/11/2009 | 223 | COT only |
| 5/26/2009 | 340 | COT only |
| 6/8/2009 | 2,300 | COT only |
| 6/22/2009 | 136 | COT only |
| 7/9/2009 | 546 | COT only |
| 7/23/2009 | 1,000 | COT only |
| **GeoMean:** | **367** | |
| **Count:** | **54** | |
| **Maximum:** | **22,700** | |
| **Minimum:** | **25** | |
| **Count if >400:** | **23** | |

COT = City of Tulsa data from BC-5b site.
OWRB = Oklahoma Water Resources Board BUMP data OK121300010010_001AT.
COT/OWRB avg = average of data for days when both COT and OWRB samples were collected.
FC = fecal coliform
ENT = Enterococci

| OWRB Only | E. coli | Sample Date | ENT |
|---|---|---|---|
| 05/23/2006 | 42 | 05/23/2006 | 36 |
| 06/12/2006 | 703 | 06/12/2006 | 578 |
| 06/26/2006 | 185 | 06/26/2006 | 47 |
| 07/05/2006 | 26 | 07/05/2006 | 36 |
| 07/24/2006 | 46 | 07/24/2006 | 36 |
| 08/07/2006 | 53 | 08/07/2006 | 20 |
| 08/21/2006 | 524 | 08/21/2006 | 1,747 |
| 08/22/2006 | 1,713 | 08/22/2006 | 727 |
| 09/05/2006 | 1,268 | 09/05/2006 | 427 |
| 09/18/2006 | 350 | 09/18/2006 | 1,518 |
| **GeoMean:** | **205** | | **170** |
| **Count:** | **10** | | **10** |
| **Maximum:** | **1,713** | | **1,747** |
| **Minimum:** | **26** | | **20** |
| **Countif >406** | **4** | **Countif >108** | **5** |

**2. Coal Creek (OK121300010090_00) and Ranch Creek (OK12130010060_00) Ambient Water Quality Bacteria Data**

| WQM Station | Water Body | Date | *E. Coli* (#/100ml) |
|---|---|---|---|
| OK121300-01-0090M | Coal Creek:  Hwy 11 | 9/25/2003 | 228 |
| OK121300-01-0090M | Coal Creek:  Hwy 11 | 5/27/2004 | 290 |
| OK121300-01-0090M | Coal Creek:  Hwy 11 | 6/24/2004 | 440 |
| OK121300-01-0090M | Coal Creek:  Hwy 11 | 7/22/2004 | 650 |
| OK121300-01-0090M | Coal Creek:  Hwy 11 | 8/26/2004 | 520 |
| OK121300-01-0090M | Coal Creek:  Hwy 11 | 9/16/2004 | 210 |
| OK121300-01-0090M | Coal Creek:  Hwy 11 | 6/23/2005 | 366 |
| OK121300-01-0090M | Coal Creek:  Hwy 11 | 7/21/2005 | 69 |
| OK121300-01-0090M | Coal Creek:  Hwy 11 | 8/25/2005 | 410 |
| OK121300-01-0090M | Coal Creek:  Hwy 11 | 9/29/2005 | 99 |
| OK121300-01-0060G | Ranch Creek:  Owasso | 6/26/2003 | > 2400 |
| OK121300-01-0060G | Ranch Creek:  Owasso | 7/24/2003 | 36 |
| OK121300-01-0060G | Ranch Creek:  Owasso | 8/21/2003 | 42 |
| OK121300-01-0060G | Ranch Creek:  Owasso | 9/25/2003 | 145 |
| OK121300-01-0060G | Ranch Creek:  Owasso | 5/27/2004 | 240 |
| OK121300-01-0060G | Ranch Creek:  Owasso | 6/24/2004 | 490 |
| OK121300-01-0060G | Ranch Creek:  Owasso | 7/22/2004 | 29 |
| OK121300-01-0060G | Ranch Creek:  Owasso | 8/26/2004 | 53 |
| OK121300-01-0060G | Ranch Creek:  Owasso | 9/16/2004 | > 2400 |
| OK121300-01-0060G | Ranch Creek:  Owasso | 6/23/2005 | 138 |
| OK121300-01-0060G | Ranch Creek:  Owasso | 7/21/2005 | 108 |
| OK121300-01-0060G | Ranch Creek:  Owasso | 8/25/2005 | 433 |

# 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| **OWASSO WWTP (2002 - 2009):** | | | | | | | | | | |
| OK0020303 | 2 | 47 | 001A | 5/31/2002 | 74055 | FC | 2.32 | 3.46 | 50050 | Flow |
| OK0020303 | 4.9 | 24 | 001A | 6/30/2002 | 74055 | FC | 2.58 | 3.33 | 50050 | Flow |
| OK0020303 | 3.3 | 196 | 001A | 7/31/2002 | 74055 | FC | 2.03 | 2.87 | 50050 | Flow |
| OK0020303 | 1 | 1 | 001A | 8/31/2002 | 74055 | FC | 2.28 | 3.57 | 50050 | Flow |
| OK0020303 | 1 | 1 | 001A | 9/30/2002 | 74055 | FC | 2.1 | 2.56 | 50050 | Flow |
| OK0020303 | 0 | 0 | 001A | 5/31/2003 | 74055 | FC | 2.49 | 3.34 | 50050 | Flow |
| OK0020303 | 34.79 | 90 | 001A | 6/30/2003 | 74055 | FC | 2.61 | 3.1 | 50050 | Flow |
| OK0020303 | 30 | 51 | 001A | 7/31/2003 | 74055 | FC | 2.25 | 2.99 | 50050 | Flow |
| OK0020303 | 26 | 70 | 001A | 8/31/2003 | 74055 | FC | 2.32 | 3.51 | 50050 | Flow |
| OK0020303 | 7.84 | 15 | 001A | 9/30/2003 | 74055 | FC | 2.76 | 3.76 | 50050 | Flow |
| OK0020303 | 26.1 | 69 | 001A | 5/31/2004 | 74055 | FC | 2.68 | 3.38 | 50050 | Flow |
| OK0020303 | 4.09 | 14 | 001A | 6/30/2004 | 74055 | FC | 2.19 | 3.31 | 50050 | Flow |
| OK0020303 | 7.75 | 17 | 001A | 7/31/2004 | 74055 | FC | 2.87 | 3.87 | 50050 | Flow |
| OK0020303 | 21.5 | 198 | 001A | 8/31/2004 | 74055 | FC | 2.54 | 3.52 | 50050 | Flow |
| OK0020303 | 28.32 | 322 | 001A | 9/30/2004 | 74055 | FC | 2.13 | 2.75 | 50050 | Flow |
| OK0020303 | 9.43 | 16 | 001A | 5/31/2005 | 74055 | FC | 2.51 | 2.95 | 50050 | Flow |
| OK0020303 | 7.58 | 16 | 001A | 6/30/2005 | 74055 | FC | 2.56 | 2.95 | 50050 | Flow |
| OK0020303 | 24.5 | 34 | 001A | 7/31/2005 | 74055 | FC | 2.38 | 3.88 | 50050 | Flow |
| OK0020303 | 16.3 | 76 | 001A | 8/31/2005 | 74055 | FC | 2.82 | 3.63 | 50050 | Flow |
| OK0020303 | 8.97 | 12 | 001A | 9/30/2005 | 74055 | FC | 2.73 | 3.57 | 50050 | Flow |
| OK0020303 | 66.75 | 89 | 001A | 5/31/2006 | 74055 | FC | 2.97 | 5.22 | 50050 | Flow |
| OK0020303 | 101.4 | 220 | 001A | 6/30/2006 | 74055 | FC | 2.68 | 3.38 | 50050 | Flow |
| OK0020303 | 65 | 84 | 001A | 7/31/2006 | 74055 | FC | 2.73 | 3.61 | 50050 | Flow |
| OK0020303 | 67.2 | 130 | 001A | 8/31/2006 | 74055 | FC | 2.58 | 3.19 | 50050 | Flow |
| OK0020303 | 79.75 | 98 | 001A | 9/30/2006 | 74055 | FC | 2.54 | 3.02 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| OK0020303 | 52.5 | 137 | 001A | 5/31/2007 | 74055 | FC | 3.8 | 4.2 | 50050 | Flow |
| OK0020303 | 92 | 157 | 001A | 6/30/2007 | 74055 | FC | 3.4 | 4 | 50050 | Flow |
| OK0020303 | 55.5 | 100 | 001A | 7/31/2007 | 74055 | FC | 3.32 | 4.63 | 50050 | Flow |
| OK0020303 | 56.4 | 89 | 001A | 8/31/2007 | 74055 | FC | 2.76 | 4.05 | 50050 | Flow |
| OK0020303 | 53 | 82 | 001A | 9/30/2007 | 74055 | FC | 2.7 | 3.3 | 50050 | Flow |
| OK0020303 | 102.25 | 121 | 001A | 5/31/2008 | 74055 | FC | 3.25 | 3.89 | 50050 | Flow |
| OK0020303 | 82.88 | 121 | 001A | 6/30/2008 | 74055 | FC | 3.53 | 4.28 | 50050 | Flow |
| OK0020303 | 143.27 | 162 | 001A | 7/31/2008 | 74055 | FC | 3.43 | 3.85 | 50050 | Flow |
| OK0020303 | 157.69 | 180 | 001A | 8/31/2008 | 74055 | FC | 3.04 | 3.55 | 50050 | Flow |
| OK0020303 | 189.75 | 386 | 001A | 9/30/2008 | 74055 | FC | 2.86 | 3.39 | 50050 | Flow |
| OK0020303 | 17.41 | 32 | 001A | 5/31/2009 | 74055 | FC | 3.58 | 4.13 | 50050 | Flow |
| OK0020303 | 120.25 | 242 | 001A | 6/30/2009 | 74055 | FC | 3.21 | 3.91 | 50050 | Flow |
| OK0020303 | 152.94 | 169 | 001A | 7/31/2009 | 74055 | FC | 2.89 | 3.36 | 50050 | Flow |
| OK0020303 | 128 | 348 | 001A | 8/31/2009 | 74055 | FC | 2.87 | 3.44 | 50050 | Flow |
| **NORTHSIDE WWTP (2001 - 2009):** | | | | | | | | | | |
| OK0026221 | 3 | 15 | 002A | 9/30/2001 | 74055 | FC | 22.98 | 30 | 50050 | Flow |
| OK0026221 | 9 | 17 | 002A | 5/31/2002 | 74055 | FC | 32.2 | 65.1 | 50050 | Flow |
| OK0026221 | 8 | 26 | 002A | 6/30/2002 | 74055 | FC | 31 | 67.9 | 50050 | Flow |
| OK0026221 | 5 | 12 | 002A | 7/31/2002 | 74055 | FC | 24.77 | 32 | 50050 | Flow |
| OK0026221 | 25 | 103 | 002A | 8/31/2002 | 74055 | FC | 24.59 | 46.6 | 50050 | Flow |
| OK0026221 | 6 | 11 | 002A | 9/30/2002 | 74055 | FC | 22.65 | 29.3 | 50050 | Flow |
| OK0026221 | 3 | 7 | 002A | 5/31/2003 | 74055 | FC | 28.73 | 47.33 | 50050 | Flow |
| OK0026221 | 2 | 3 | 002A | 6/30/2003 | 74055 | FC | 28.12 | 49.9 | 50050 | Flow |
| OK0026221 | 2 | 4 | 002A | 7/31/2003 | 74055 | FC | 24.41 | 33.2 | 50050 | Flow |
| OK0026221 | 6 | 9 | 002A | 8/31/2003 | 74055 | FC | 26.08 | 67.03 | 50050 | Flow |
| OK0026221 | 13 | 151 | 002A | 9/30/2003 | 74055 | FC | 34.75 | 75.47 | 50050 | Flow |
| OK0026221 | 4 | 6 | 002A | 5/31/2004 | 74055 | FC | 29.95 | 50.8 | 50050 | Flow |
| OK0026221 | 2 | 7 | 002A | 6/30/2004 | 74055 | FC | 30.83 | 60.7 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| OK0026221 | 9 | 21 | 002A | 7/31/2004 | 74055 | FC | 35.05 | 62.9 | 50050 | Flow |
| OK0026221 | 2 | 6 | 002A | 8/31/2004 | 74055 | FC | 25.16 | 35.5 | 50050 | Flow |
| OK0026221 | 13 | 30 | 002A | 9/30/2004 | 74055 | FC | 22.77 | 25 | 50050 | Flow |
| OK0026221 | 17 | 25 | 002A | 5/31/2005 | 74055 | FC | 23.06 | 35.3 | 50050 | Flow |
| OK0026221 | 19 | 49 | 002A | 6/30/2005 | 74055 | FC | 22.15 | 38.4 | 50050 | Flow |
| OK0026221 | 10 | 17 | 002A | 7/31/2005 | 74055 | FC | 20.72 | 28.5 | 50050 | Flow |
| OK0026221 | 14 | 39 | 002A | 8/31/2005 | 74055 | FC | 24.14 | 41.7 | 50050 | Flow |
| OK0026221 | 17 | 38 | 002A | 9/30/2005 | 74055 | FC | 22.74 | 46.1 | 50050 | Flow |
| OK0026221 | 6 | 29 | 002A | 5/31/2006 | 74055 | FC | 31.36 | 69.5 | 50050 | Flow |
| OK0026221 | 3 | 4 | 002A | 6/30/2006 | 74055 | FC | 22 | 30.7 | 50050 | Flow |
| OK0026221 | 5 | 24 | 002A | 7/31/2006 | 74055 | FC | 22.91 | 49.2 | 50050 | Flow |
| OK0026221 | 4 | 12 | 002A | 8/31/2006 | 74055 | FC | 22.75 | 30.6 | 50050 | Flow |
| OK0026221 | 5 | 12 | 002A | 9/30/2006 | 74055 | FC | 20.92 | 26.4 | 50050 | Flow |
| OK0026221 | 3 | 5 | 002A | 5/31/2007 | 74055 | FC | 43.43 | 82.07 | 50050 | Flow |
| OK0026221 | 9 | 0 | 002A | 6/30/2007 | 74055 | FC | 45.12 | 88.6 | 50050 | Flow |
| OK0026221 | 36 | 6.7 | 002A | 7/31/2007 | 74055 | FC | 36.85 | 82.6 | 50050 | Flow |
| OK0026221 | 13 | 3.2 | 002A | 8/31/2007 | 74055 | FC | 22.34 | 25 | 50050 | Flow |
| OK0026221 | 7 | 0 | 002A | 9/30/2007 | 74055 | FC | 26.44 | 56.24 | 50050 | Flow |
| OK0026221 | 21 | 3.3 | 002A | 5/31/2008 | 74055 | FC | 38.76 | 76.09 | 50050 | Flow |
| OK0026221 | 12 | 6.5 | 002A | 6/30/2008 | 74055 | FC | 49.64 | 91 | 50050 | Flow |
| OK0026221 | 19 | 10 | 002A | 7/31/2008 | 74055 | FC | 30.76 | 61.79 | 50050 | Flow |
| OK0026221 | 5 | 0 | 002A | 8/31/2008 | 74055 | FC | 23.24 | 34.39 | 50050 | Flow |
| OK0026221 | 2 | 0 | 002A | 9/30/2008 | 74055 | FC | 31.29 | 73.1 | 50050 | Flow |
| OK0026221 | 3 | 0 | 002A | 5/31/2009 | 74055 | FC | 45.64 | 77.8 | 50050 | Flow |
| OK0026221 | 29 | 9.7 | 002A | 6/30/2009 | 74055 | FC | 25.94 | 36.2 | 50050 | Flow |
| OK0026221 | 15 | 10 | 002A | 7/31/2009 | 74055 | FC | 22.29 | 37.9 | 50050 | Flow |
| OK0026221 | 37 | 9.7 | 002A | 8/31/2009 | 74055 | FC | 23.06 | 38 | 50050 | Flow |
| **LOWER BIRD CREEK REGIONAL WWTP (1999 - 2009):** | | | | | | | | | | |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| OK0042935 | 4 | 43 | 001A | 5/31/1999 | 74055 | FC | 0.26 | 0.75 | 50050 | Flow |
| OK0042935 | 12 | 74 | 001A | 6/30/1999 | 74055 | FC | 0.23 | 0.35 | 50050 | Flow |
| OK0042935 | 9 | 314 | 001A | 7/31/1999 | 74055 | FC | 0.19 | 0.31 | 50050 | Flow |
| OK0042935 | 7 | 12 | 001A | 8/31/1999 | 74055 | FC | 0.19 | 0.28 | 50050 | Flow |
| OK0042935 | 10 | 48 | 001A | 9/30/1999 | 74055 | FC | 0.2 | 0.29 | 50050 | Flow |
| OK0042935 | 7 | 33 | 001A | 5/31/2000 | 74055 | FC | 0.26 | 0.48 | 50050 | Flow |
| OK0042935 | 5.1 | 749 | 001A | 6/30/2000 | 74055 | FC | 0.3 | 0.5 | 50050 | Flow |
| OK0042935 | 7 | 260 | 001A | 7/31/2000 | 74055 | FC | 0.22 | 0.34 | 50050 | Flow |
| OK0042935 | 6 | 8 | 001A | 8/31/2000 | 74055 | FC | 0.33 | 0.78 | 50050 | Flow |
| OK0042935 | 13 | 60 | 001A | 9/30/2000 | 74055 | FC | 0.2 | 0.28 | 50050 | Flow |
| OK0042935 | 3 | 7 | 001A | 5/31/2001 | 74055 | FC | 0.16 | 0.27 | 50050 | Flow |
| OK0042935 | 20 | 235 | 001A | 6/30/2001 | 74055 | FC | 0.18 | 0.39 | 50050 | Flow |
| OK0042935 | 9 | 48 | 001A | 7/31/2001 | 74055 | FC | 0.13 | 0.24 | 50050 | Flow |
| OK0042935 | 12 | 29 | 001A | 8/31/2001 | 74055 | FC | 0.15 | 0.25 | 50050 | Flow |
| OK0042935 | 9 | 112 | 001A | 9/30/2001 | 74055 | FC | 0.14 | 0.24 | 50050 | Flow |
| OK0042935 | 4 | 20 | 001A | 5/31/2002 | 74055 | FC | 0.26 | 0.46 | 50050 | Flow |
| OK0042935 | 14 | 17 | 001A | 6/30/2002 | 74055 | FC | 0.26 | 0.4 | 50050 | Flow |
| OK0042935 | 8 | 13 | 001A | 7/31/2002 | 74055 | FC | 0.25 | 0.35 | 50050 | Flow |
| OK0042935 | 5 | 16 | 001A | 8/31/2002 | 74055 | FC | 0.29 | 0.63 | 50050 | Flow |
| OK0042935 | 6 | 22 | 001A | 9/30/2002 | 74055 | FC | 0.28 | 0.36 | 50050 | Flow |
| OK0042935 | 11 | 90 | 001A | 5/31/2003 | 74055 | FC | 0.26 | 0.56 | 50050 | Flow |
| OK0042935 | 11 | 20 | 001A | 6/30/2003 | 74055 | FC | 0.29 | 0.57 | 50050 | Flow |
| OK0042935 | 10 | 27 | 001A | 7/31/2003 | 74055 | FC | 0.26 | 0.39 | 50050 | Flow |
| OK0042935 | 32 | 86 | 001A | 8/31/2003 | 74055 | FC | 0.29 | 0.75 | 50050 | Flow |
| OK0042935 | 25 | 39 | 001A | 9/30/2003 | 74055 | FC | 0.33 | 1.19 | 50050 | Flow |
| OK0042935 | 45 | 300 | 001A | 5/31/2004 | 74055 | FC | 0.28 | 0.48 | 50050 | Flow |
| OK0042935 | 5 | 125 | 001A | 6/30/2004 | 74055 | FC | 0.26 | 0.46 | 50050 | Flow |
| OK0042935 | 3 | 30 | 001A | 7/31/2004 | 74055 | FC | 0.3 | 0.53 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|
| OK0042935 | 1 | 6 | 001A | 8/31/2004 | 74055 | FC | 0.27 | 0.4 | 50050 | Flow |
| OK0042935 | 1 | 20 | 001A | 9/30/2004 | 74055 | FC | 0.24 | 0.43 | 50050 | Flow |
| OK0042935 | 2 | 8 | 001A | 5/31/2005 | 74055 | FC | 0.25 | 0.42 | 50050 | Flow |
| OK0042935 | 4 | 39 | 001A | 6/30/2005 | 74055 | FC | 0.28 | 0.42 | 50050 | Flow |
| OK0042935 | 8 | 141 | 001A | 7/31/2005 | 74055 | FC | 0.27 | 0.44 | 50050 | Flow |
| OK0042935 | 32 | 400 | 001A | 8/31/2005 | 74055 | FC | 0.31 | 0.54 | 50050 | Flow |
| OK0042935 | 2 | 19 | 001A | 9/30/2005 | 74055 | FC | 0.28 | 0.5 | 50050 | Flow |
| OK0042935 | 2 | 76 | 001A | 5/31/2006 | 74055 | FC | 0.37 | 0.64 | 50050 | Flow |
| OK0042935 | 2 | 38 | 001A | 6/30/2006 | 74055 | FC | 0.36 | 0.6 | 50050 | Flow |
| OK0042935 | 4 | 964 | 001A | 7/31/2006 | 74055 | FC | 0.35 | 0.69 | 50050 | Flow |
| OK0042935 | 1 | 1 | 001A | 8/31/2006 | 74055 | FC | 0.36 | 0.52 | 50050 | Flow |
| OK0042935 | 1 | 1 | 001A | 9/30/2006 | 74055 | FC | 0.28 | 0.54 | 50050 | Flow |
| OK0042935 | 2 | 60 | 001A | 5/31/2007 | 74055 | FC | 0.44 | 0.89 | 50050 | Flow |
| OK0042935 | 1 | 1 | 001A | 6/30/2007 | 74055 | FC | 0.45 | 1.02 | 50050 | Flow |
| OK0042935 | 1 | 2 | 001A | 7/31/2007 | 74055 | FC | 0.43 | 0.68 | 50050 | Flow |
| OK0042935 | 8 | 36 | 001A | 8/31/2007 | 74055 | FC | 0.36 | 0.97 | 50050 | Flow |
| OK0042935 | 1 | 2 | 001A | 9/30/2007 | 74055 | FC | 0.6 | 1.39 | 50050 | Flow |
| OK0042935 | 10 | 177 | 001A | 5/31/2008 | 74055 | FC | 0.45 | 1.09 | 50050 | Flow |
| OK0042935 | 7 | 727 | 001A | 6/30/2008 | 74055 | FC | 0.51 | 0.99 | 50050 | Flow |
| OK0042935 | 11 | 52 | 001A | 7/31/2008 | 74055 | FC | 0.47 | 0.89 | 50050 | Flow |
| OK0042935 | 17 | 128 | 001A | 8/31/2008 | 74055 | FC | 0.45 | 0.84 | 50050 | Flow |
| OK0042935 | 23 | 173 | 001A | 9/30/2008 | 74055 | FC | 0.41 | 0.8 | 50050 | Flow |
| OK0042935 | 1 | 1 | 001A | 5/31/2009 | 74055 | FC | 0.55 | 1.06 | 50050 | Flow |
| OK0042935 | <1 | <1 | 001A | 6/30/2009 | 74055 | FC | 0.43 | 0.75 | 50050 | Flow |
| OK0042935 | <1 | <1 | 001A | 7/31/2009 | 74055 | FC | 0.43 | 0.77 | 50050 | Flow |
| OK0042935 | 1 | 1 | 001A | 8/31/2009 | 74055 | FC | 0.49 | 0.74 | 50050 | Flow |

# ODEQ Summary of Available Reports of Sanitary Sewer Overflows

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| OWASSO | 10/1/2004 | S21310 | 606 N. ATLANTA | 20 | GREASE | |
| OWASSO | 10/2/2004 | S21310 | 8701 N. 120TH E. AVE | 400 | GREASE | |
| OWASSO | 10/2/2004 | S21310 | 402 N. BIRCH | 200 | GREASE | |
| OWASSO | 11/20/2004 | S21310 | 103RD ST. N. & 145TH E. AVE | 700 | BLOWN FORCE MAIN | PIPE |
| OWASSO | 11/23/2004 | S21310 | 203 E. 8TH | 25 | GREASE & PAPER TOWELS | MANHOLE |
| OWASSO | 1/15/2005 | S21310 | 11407 N. 96TH E. AVE | 100 | BLOCKAGE | MANHOLE |
| OWASSO | 1/15/2005 | S21310 | 8731 N. 121ST E. AVE | 100 | BLOCKAGE | MANHOLE |
| OWASSO | 2/3/2005 | S21310 | 12603 E. 84TH ST. N. | 300 | DEBRIS | |
| OWASSO | 2/3/2005 | S21310 | 12002 N. 107TH E. AVE | 150 | GREASE | MANHOLE |
| OWASSO | 2/6/2005 | S21310 | 7714 E. 77TH ST. N. | 200 | GREASE | MANHOLE |
| OWASSO | 2/9/2005 | S21310 | 102 W. 5TH | 100 | RAGS & GREASE | MANHOLE |
| OWASSO | 2/20/2005 | S21310 | 305 W. 17 | 100 | GREASE | |
| OWASSO | 3/11/2005 | S21310 | E. 2ND & BIRCH/ 1ST & ATLANTA | 200 | GREASE & GRAVEL | MANHOLE |
| OWASSO | 3/17/2005 | S21310 | 8912 N. 120TH E. AVE | 300 | GREASE & RAGS | |
| OWASSO | 3/18/2005 | S21310 | 605 N. CEDAR | 50 | GREASE | MANHOLE |
| OWASSO | 4/17/2005 | S21310 | 12147 N. 97TH E. AVE | 250 | GREASE | MANHOLE |
| OWASSO | 4/18/2005 | S21310 | 303 E. 24TH CT. | 100 | GREASE & RAGS | MANHOLE |
| OWASSO | 4/21/2005 | S21310 | 303 W. 17 | 25 | GREASE | |
| OWASSO | 4/24/2005 | S21310 | 11803 E. 80TH PL. N. | 200 | GREASE | MANHOLE |
| OWASSO | 5/9/2005 | S21310 | 207 W. 17TH | 100 | GREASE | MANHOLE |
| OWASSO | 5/29/2005 | S21310 | ATOR HEIGHTS SUBDIVISION ON BAILEY RANCH GOLF COURSE | 300 | GREASE | MANHOLE |
| OWASSO | 6/6/2005 | S21310 | 10304 E. 92ND PL.N. | 150 | ROOTS & GREASE | MANHOLE |
| OWASSO | 6/9/2005 | S21310 | 8720 N. 120TH E. AVE | 50 | GREASE | |
| OWASSO | 6/15/2005 | S21310 | 301 W. 17TH AVE | 100 | RAGS | |
| OWASSO | 6/17/2005 | S21310 | 500 S. MAIN | 100 | PUMP FAILURE | |
| OWASSO | 7/7/2005 | S21310 | 11305 N. 110TH E. AVE & 10621 E. 113TH ST N. | 200 | GREASE | |
| OWASSO | 8/30/2005 | S21310 | 600 S. MAIN - PLANT | 2 | BROKEN VALVE | DIGESTER |
| OWASSO | 9/11/2005 | S21310 | 12105 E. 89TH ST. N. | 300 | GREASE | MANHOLE |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| OWASSO | 10/25/2005 | S21310 | 8001 N. OWASSO EXPRESSWAY | 300 | BROKEN PIPES | PIPE |
| OWASSO | 10/25/2005 | S21310 | 7801 N. OWASSO EXPRESSWAY | 300 | BROKEN PIPE | PIPE |
| OWASSO | 10/25/2005 | S21310 | 7703 N. OWASSO EXPRESSWAY | 300 | BROKEN PIPE | PIPE |
| OWASSO | 12/20/2005 | S21310 | 12601 E. 86TH ST. N. | 100 | GREASE | MANHOLE |
| OWASSO | 12/25/2005 | S21310 | 10304 E. 92ND PL. N. | 300 | GREASE | MANHOLE |
| OWASSO | 12/28/2005 | S21310 | 8904 N. 97TH E. AVE | 50 | RAGS & GREASE | MANHOLE |
| OWASSO | 1/3/2006 | S21310 | 417 S. BIRCH | 50 | GREASE | MANHOLE |
| OWASSO | 1/7/2006 | S21310 | 501 E. 3RD | 25 | GREASE | |
| OWASSO | 1/14/2006 | S21310 | 11303 N. 96TH E. AVE | 200 | BLOCKAGE | |
| OWASSO | 1/24/2006 | S21310 | 303 W. 17 | 75 | GREASE | MANHOLE |
| OWASSO | 2/1/2006 | S21310 | 10229 E. 96TH ST. N. | 100 | GREASE | MANHOLE |
| OWASSO | 2/8/2006 | S21310 | 101 N. ATLANTA | 50 | GREASE | MANHOLE |
| OWASSO | 2/8/2006 | S21310 | 104 E. 20TH CT.N | 10 | GREASE | MANHOLE |
| OWASSO | 2/22/2006 | S21310 | 301 W. 2ND | 100 | GREASE & RAGS | |
| OWASSO | 3/6/2006 | S21310 | 11401 E. 105TH ST. E. AVE | 300 | GREASE | MANHOLE |
| OWASSO | 3/10/2006 | S21310 | 10602 E. 96TH PL. N. | 100 | GREASE | MANHOLE |
| OWASSO | 3/10/2006 | S21310 | 10229 E. 96TH ST.N. | 100 | GREASE | MANHOLE |
| OWASSO | 3/10/2006 | S21310 | 10221 E. 96TH ST. N. | 100 | GREASE | MANHOLE |
| OWASSO | 3/16/2006 | S21310 | WWTP | 400 | FOAMING | LAGOON/BASIN |
| OWASSO | 3/28/2006 | S21310 | 602 E. 8TH ST. N. | 50 | GREASE & RAGS | MANHOLE |
| OWASSO | 4/20/2006 | S21310 | 212 W. 18TH | 200 | GREASE | MANHOLE |
| OWASSO | 4/30/2006 | S21310 | SMITH FARMS | 100 | GREASE | MANHOLE |
| OWASSO | 5/18/2006 | S21310 | 302 N. CARLSBAD | 150 | SOLIDS COLLECTED IN INVERT | MANHOLE |
| OWASSO | 5/22/2006 | S21310 | 11314 N. 94TH E. AVE | 50 | ROOTS | MANHOLE |
| OWASSO | 5/22/2006 | S21310 | 12105 E. 89TH ST. N | 100 | RAGS & GREASE | MANHOLE |
| OWASSO | 7/13/2006 | S21310 | 313 N. CARLSBAD | 100 | GREASE & RAGS | |
| OWASSO | 8/18/2006 | S21310 | 7714 N. 130TH E. AVE | 100 | ROOTS | |
| OWASSO | 9/9/2006 | S21310 | 212 W. 18TH | 100 | GREASE | MANHOLE |
| OWASSO | 9/15/2006 | S21310 | 202 W. 11TH | 100 | GREASE | |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| OWASSO | 10/30/2006 | S21310 | | 100 | GREASE | MANHOLE |
| OWASSO | 11/4/2006 | S21310 | 2000 N. GARNETT | 200 | BUCKET IN MANHOLE | MANHOLE |
| OWASSO | 11/7/2006 | S21310 | | 50 | GREASE | |
| OWASSO | 11/7/2006 | S21310 | | 250 | GREASE | |
| OWASSO | 11/23/2006 | S21310 | 10803 E. 112TH ST. N. | 200 | GREASE | |
| OWASSO | 11/26/2006 | S21310 | 8706 N. 120TH E. AVE | 100 | GREASE | |
| OWASSO | 12/6/2006 | S21310 | 96TH ST. N. & 119TH E. AVE. | 300 | GREASE | MANHOLE |
| OWASSO | 12/6/2006 | S21310 | 96TH ST. N. & 119TH E. AVE | 300 | GREASE | MANHOLE |
| OWASSO | 12/10/2006 | S21310 | 7714 N. 129TH E. AVE. | 200 | GREASE | MANHOLE |
| OWASSO | 12/13/2006 | S21310 | 602 E. 8TH | 200 | GREASE | MANHOLE |
| OWASSO | 12/29/2006 | S21310 | 1400 N. MAIN | 150 | GREASE | MANHOLE |
| OWASSO | 12/30/2006 | S21310 | 96TH ST. N. & 119TH E. AVE. | 100 | GREASE | |
| OWASSO | 1/27/2007 | S21310 | 8201 N. 117TH E. AVE | 650 | GREASE | |
| OWASSO | 2/21/2007 | S21310 | 303 W. 17TH | 200 | GREASE | MANHOLE |
| OWASSO | 2/23/2007 | S21310 | 7801 N. OWASSO EXPRESSWAY | 200 | GREASE | MANHOLE |
| OWASSO | 2/27/2007 | S21310 | 301 W. 17TH ST. N. | 100 | RAGS | MANHOLE |
| OWASSO | 2/28/2007 | S21310 | W. 18TH ST. N. ON GOLF COURSE | 100 | GREASE | MANHOLE |
| OWASSO | 3/19/2007 | S21310 | 12402 E. 89TH | 150 | GREASE | MANHOLE |
| OWASSO | 3/21/2007 | S21310 | 12701 E. 74TH ST. N. | 50 | ROOTS | MANHOLE |
| OWASSO | 3/28/2007 | S21310 | 206 W. 17TH | 200 | ROOTS | MANHOLE |
| OWASSO | 4/23/2007 | S21310 | 412 & 602 N. CARLSBAD | 200 | GREASE | |
| OWASSO | 4/28/2007 | S21310 | 106 E. AVE. & 104TH ST. N. | 25 | LEAK | MANHOLE |
| OWASSO | 5/7/2007 | S21310 | 10320 E. 110TH PL. N. | 700 | RAIN | MANHOLE |
| OWASSO | 5/7/2007 | S21310 | 7720 OWASSO EXPRESSWAY | 1,050 | RAIN | |
| OWASSO | 5/7/2007 | S21310 | 109 N. BIRCH | 1,050 | RAIN | MANHOLE |
| OWASSO | 5/7/2007 | S21310 | 401 N. CEDAR | 1,050 | RAIN | MANHOLE |
| OWASSO | 6/27/2007 | S21310 | 109 N. BIRCH | 500 | RAIN | |
| OWASSO | 6/27/2007 | S21310 | 1065 E. 114TH ST. N. | 200 | RAIN | |
| OWASSO | 6/27/2007 | S21310 | 401 N. CEDAR | 200 | RAIN | |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| OWASSO | 6/27/2007 | S21310 | 10320 E. 110TH PL. N. | 700 | RAIN | |
| OWASSO | 7/26/2007 | S21310 | 810 & 902 ASH | 10 | GREASE | MANHOLE |
| OWASSO | 8/22/2007 | S21310 | 305 W. 17TH | 100 | GREASE | |
| OWASSO | 8/22/2007 | S21310 | 305 W. 17TH | 100 | GREASE | MANHOLE |
| OWASSO | 8/31/2007 | S21310 | 716 N. ATLANTA | 100 | GREASE | MANHOLE |
| OWASSO | 9/26/2007 | S21310 | 205 E. 2ND | 350 | DEBRIS | |
| OWASSO | 9/26/2007 | S21310 | | 25 | BLOCKAGE | MANHOLE |
| OWASSO | 10/26/2007 | S21310 | 610 N. CEDAR | 200 | GREASE & RAGS | MANHOLE |
| OWASSO | 11/1/2007 | S21310 | 305 W. 17TH | 100 | GREASE | |
| OWASSO | 11/3/2007 | S21310 | E. 95TH ST. N. & GARNETT | 50,000 | PVP PIPE IN MH | MANHOLE |
| OWASSO | 11/28/2007 | S21310 | 303 W. 17TH | 150 | GREASE | MANHOLE |
| OWASSO | 3/18/2008 | S21310 | 109 N. BIRCH | 1,350 | FLOODING | MANHOLE |
| OWASSO | 3/31/2008 | S21310 | 1814 N. MAIN | 200 | GREASE & ROOTS | MANHOLE |
| OWASSO | 4/8/2008 | S21310 | 308 S. MAIN | 600 | RAIN | MANHOLE |
| OWASSO | 4/8/2008 | S21310 | 109 N BIRCH | 600 | RAIN | MANHOLE |
| OWASSO | 4/9/2008 | S21310 | 109 N. BIRCH | 1,600 | RAIN | MANHOLE |
| OWASSO | 4/22/2008 | S21310 | 11101 N. 99TH E. AVE | 2,000 | GREASE & RAGE | MANHOLE |
| OWASSO | 5/7/2008 | S21310 | 109 N. BIRCH | 1,200 | RAIN | MANHOLE |
| OWASSO | 5/7/2008 | S21310 | 109 N. BIRCH | 1,200 | FLOODING | MANHOLE |
| OWASSO | 6/9/2008 | S21310 | 109 N. BIRCH | 1,200 | OVERFLOW | MANHOLE |
| OWASSO | 6/9/2008 | S21310 | 401 N. CEDAR | 1,200 | RAIN | MANHOLE |
| OWASSO | 6/9/2008 | S21310 | 113 S. ATLANTA | 1,200 | RAIN | MANHOLE |
| OWASSO | 6/9/2008 | S21310 | 109 S. BIRCH | 1,200 | RAIN | MANHOLE |
| OWASSO | 6/16/2008 | S21310 | 107 N. BIRCH | 1,200 | RAIN | MANHOLE |
| OWASSO | 6/16/2008 | S21310 | 308 S. MAIN | 2,100 | RAIN | MANHOLE |
| OWASSO | 6/16/2008 | S21310 | 109 N. BIRCH | 250 | RAIN | MANHOLE |
| OWASSO | 6/16/2008 | S21310 | 109 N. BIRCH | 1,300 | RAIN | MANHOLE |
| OWASSO | 6/17/2008 | S21310 | 600 S. BIRCH | > 1,000,000 | RAIN | LAGOON/BASIN |
| OWASSO | 6/30/2008 | S21310 | 10320 E 116TH ST. N | 200 | RAIN GUARD CLOGGED EFFLUENT PIPE | MANHOLE |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| OWASSO | 7/1/2008 | S21310 | 10320 E. 116TH ST. | 500 | RAIN GUARD FELL INTO MANHOLE AND PLUGGED IT | MANHOLE |
| OWASSO | 7/10/2008 | S21310 | 305 W. 17TH | 200 | GREASE | MANHOLE |
| OWASSO | 7/27/2008 | S21310 | 8902 N. 125TH E. AVE. | 300 | GREASE BLOCKAGE IN EFFLUENT SIDE OF UPSTREAM MANHOLE | MANHOLE |
| OWASSO | 7/28/2008 | S21310 | 8902 N. 125TH E. AVE | 100 | GREASE | MANHOLE |
| OWASSO | 8/2/2008 | S21310 | 11314 N. 94TH E. AVE | 150 | TOILET PAPER | MANHOLE |
| OWASSO | 8/9/2008 | S21310 | 11401 E. 105TH ST. N. | 400 | BUILD UP OF GREASE | MANHOLE |
| OWASSO | 9/17/2008 | S21310 | MANHOLES | | PUMP FAILURE | MANHOLE |
| OWASSO | 9/24/2008 | S21310 | 10605 E. 114TH ST. N. | 400 | GREASE | MANHOLE |
| OWASSO | 10/30/2008 | S21310 | 9760 N. 97TH E. AVE | 100 | ROOTS | MANHOLE |
| OWASSO | 11/9/2008 | S21310 | 8912 N. 121ST E. AVE | 25 | GREASE | |
| OWASSO | 11/27/2008 | S21310 | 401 N. CEDAR | 500 | GREASE CLOG | MANHOLE |
| OWASSO | 11/27/2008 | S21310 | 401 N. CEDAR | 500 | GREASE | MANHOLE |
| OWASSO | 11/29/2008 | S21310 | 600 SOUTH MAIN | 1,000 | CAP FROM DIGESTER BLEW OFF | DIGESTER |
| OWASSO | 11/29/2008 | S21310 | 600 S. MAIN | 1,000 | CAP ON THE LINE RUNNING FROM THE DIGESTERS BLEW OFF | DIGESTER |
| OWASSO | 12/7/2008 | S21310 | | 500 | GREASE | MANHOLE |
| OWASSO | 12/25/2008 | S21310 | 303 N. ELM PL. | 300 | ROOTS | MANHOLE |
| OWASSO | 12/27/2008 | S21310 | 11881 N. 97TH E. AVE | 400 | ROOTS | MANHOLE |
| OWASSO | 12/27/2008 | S21310 | 12147 N. 95TH E. AVE | 400 | GREASE | MANHOLE |
| OWASSO | 2/10/2009 | S21310 | 11530E 114TH ST. N. | 200 | BLOCKAGE IN THE MAIN LINE | MANHOLE |
| OWASSO | 2/11/2009 | S21310 | 11530 E. 114TH ST. N. | 200 | ROOTS | MANHOLE |
| OWASSO | 2/22/2009 | S21310 | 103RD ST. N. & 145TH E. AVE | 550 | MAIN BREAK | PIPE |
| OWASSO | 3/31/2009 | S21310 | 9508 N. 121ST | 100 | CLOGGED LINE | MANHOLE |
| OWASSO | 4/6/2009 | S21310 | 209 W. 2ND | 500 | BLOCKAGE | |
| OWASSO | 4/16/2009 | S21310 | 12115 N 95TH E. AVE. | 300 | DEBRIS IN LINE | MANHOLE |
| OWASSO | 4/30/2009 | S21310 | 10805 E. 114TH ST. N | 500 | RAIN | MANHOLE |
| OWASSO | 4/30/2009 | S21310 | 10530 E. 114TH ST. N | 500 | RAIN | MANHOLE |
| OWASSO | 4/30/2009 | S21310 | MH'S @ LIFT STATION | 800 | BLOCKAGE | MANHOLE |
| OWASSO | 5/1/2009 | S21310 | MH'S | 200 | RAIN | MANHOLE |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| OWASSO | 5/1/2009 | S21310 | MH'S | 100 | RAIN | MANHOLE |
| OWASSO | 5/1/2009 | S21310 | MH'S | 1,200 | RAIN | MANHOLE |
| OWASSO | 5/14/2009 | S21310 | 9411 E. 114TH ST. N. | 100 | ROOTS | |
| OWASSO | 5/14/2009 | S21310 | MANHOLES | | RAIN | MANHOLE |
| OWASSO | 5/18/2009 | S21310 | 11420 N. 91ST E. AVE | 100 | ROOTS | MANHOLE |
| OWASSO | 5/25/2009 | S21310 | 401 N. DOGWOOD | 300 | ROOTS | MANHOLE |
| OWASSO | 5/29/2009 | S21310 | 412 N. CARLSBAD | 200 | ROOTS | MANHOLE |
| OWASSO | 7/16/2009 | S21310 | 8001 N. 118TH E. AVE | 700 | CRACKED PIPE | PIPE |
| OWASSO | 8/17/2009 | S21310 | 12309 N. 95TH E. AVE | 200 | ROOTS | MANHOLE |
| OWASSO | 8/24/2009 | S21310 | 12011 E. 115TH PL. N | 50 | GREASE | MANHOLE |
| OWASSO | 9/21/2009 | S21310 | 10605 E. 114TH ST. N | 500 | RAIN | MANHOLE |
| OWASSO | 9/21/2009 | S21310 | 205 E. 1ST | 500 | RAIN | MANHOLE |
| OWASSO | 9/21/2009 | S21310 | W. OF RAILROAD TRACKS ON 86TH ST. N. | 400 | RAIN | MANHOLE |
| OWASSO | 9/21/2009 | S21310 | 402 E. 3RD | 400 | RAIN | MANHOLE |
| OWASSO | 9/30/2009 | S21310 | 209 W. 2ND ST. | 100 | GREASE | MANHOLE |
| LBCR | 2/1/2006 | S21327 | 6420 N. 209TH E. AVE | 510 | EQUIPMENT FAILURE | MANHOLE |
| NORTHSIDE | 9/18/2004 | S21309 | 1939 N. GARY AVE | 3,128 | ROOTS | MANHOLE |
| NORTHSIDE | 10/3/2004 | S21309 | 5371 E. 30TH | 3,276 | ROOTS | MANHOLE |
| NORTHSIDE | 10/12/2004 | S21309 | 8535 E. 38TH | 672 | ROOTS | MANHOLE |
| NORTHSIDE | 10/27/2004 | S21309 | 1944 N. GARY AVE | | DEBRIS | |
| NORTHSIDE | 10/27/2004 | S21309 | 1926 N. GARY AVE. | | DEBRIS | |
| NORTHSIDE | 10/27/2004 | S21309 | 1932 N. GARY AVE. | | DEBRIS | |
| NORTHSIDE | 10/31/2004 | S21309 | 754 E. 51ST ST. N. | 1,200 | ROOTS | MANHOLE |
| NORTHSIDE | 11/5/2004 | S21309 | 1315 N. LEWIS AVE | 144 | ROOTS | PIPE |
| NORTHSIDE | 11/26/2004 | S21309 | 3625 S. 114TH E. AVE | 170 | ROOT | MANHOLE |
| NORTHSIDE | 12/3/2004 | S21309 | 1607 E. UTE ST. | | ROOTS | |
| NORTHSIDE | 12/19/2004 | S21309 | 8436 E. 65TH | 2,992 | DEBRIS | MANHOLE |
| NORTHSIDE | 12/20/2004 | S21309 | 2204 N. MADISON AVE. | 2,720 | DEBRIS | MANHOLE |
| NORTHSIDE | 12/25/2004 | S21309 | 6931 E. 16TH | | ROOTS | |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 12/27/2004 | S21309 | 3010 S. SHERIDAN RD. | 8,160 | VANDALISM | MANHOLE |
| NORTHSIDE | 12/30/2004 | S21309 | 4012 E. UTE | 64 | ROOTS | |
| NORTHSIDE | 12/31/2004 | S21309 | 620 S. GARNETT RD. | 13,510 | DEBRIS | MANHOLE |
| NORTHSIDE | 12/31/2004 | S21309 | 1819 S. JOPLIN | 94 | ROOTS | |
| NORTHSIDE | 1/2/2005 | S21309 | 5726 E. 4TH TERRACE | | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 1/2/2005 | S21309 | 5733 E. 4TH PL. | 94 | BROKEN MAIN | |
| NORTHSIDE | 1/2/2005 | S21309 | 5733 E. 4TH PL. | 94 | DEBRIS | |
| NORTHSIDE | 1/4/2005 | S21309 | 11031 E. 37TH PL. | | ROOTS | MANHOLE |
| NORTHSIDE | 1/5/2005 | S21309 | 5726 E. 4TH TERR | 7,140 | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 1/5/2005 | S21309 | 4007 E. NEWTON ST. | 558,060 | RAIN | MANHOLE |
| NORTHSIDE | 1/5/2005 | S21309 | 812 N. OSWEGO AVE | 532,125 | RAIN | MANHOLE |
| NORTHSIDE | 1/5/2005 | S21309 | 1017 N. VANDALIA AVE | 2,706 | GREASE | |
| NORTHSIDE | 1/5/2005 | S21309 | BROKEN MAIN | 94 | BROKEN MAIN | |
| NORTHSIDE | 1/5/2005 | S21309 | 1017 N. VANDALIA AVE | 2,706 | GREASE | |
| NORTHSIDE | 1/6/2005 | S21309 | 5733 E. 4TH PL. | 187 | DEBRIS | |
| NORTHSIDE | 1/15/2005 | S21309 | 3028 S. 132TH E. AVE | 3,840 | ROOT | MANHOLE |
| NORTHSIDE | 1/19/2005 | S21309 | 3425 S. SHERIDAN RD. | 2,475 | VANDALISM | |
| NORTHSIDE | 1/21/2005 | S21309 | 16709 E. ADMIRAL PL. | | VANDALISM | MANHOLE |
| NORTHSIDE | 1/27/2005 | S21309 | 2204 N. MADISON AVE | 5,010 | GREASE | MANHOLE |
| NORTHSIDE | 2/1/2005 | S21309 | 2921 N. ELGIN AVE. | 360 | GREASE | |
| NORTHSIDE | 2/2/2005 | S21309 | 7703 E. KING | 1,980 | BROKEN MAIN | |
| NORTHSIDE | 2/4/2005 | S21309 | 1651 N. YORKTOWN PL. | 6,120 | GREASE | MANHOLE |
| NORTHSIDE | 2/5/2005 | S21309 | 2042 S. 73RD E. AVE | | GREASE | |
| NORTHSIDE | 2/8/2005 | S21309 | 8350 E. 25TH PL. | 32,640 | GREASE | MANHOLE |
| NORTHSIDE | 2/10/2005 | S21309 | 3808 E. WOODROW ST. | 2,160 | ROOT | MANHOLE |
| NORTHSIDE | 2/11/2005 | S21309 | 307 E. 58TH ST N. | | ROOTS | |
| NORTHSIDE | 2/13/2005 | S21309 | 11418 E. 34 | 4,920 | ROOTS | |
| NORTHSIDE | 2/17/2005 | S21309 | 12788 E. 39 | | ROOT | |
| NORTHSIDE | 2/17/2005 | S21309 | 12786 E. 39 | | ROOT | |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 2/17/2005 | S21309 | 12817 E. 40 | | ROOT | |
| NORTHSIDE | 2/18/2005 | S21309 | 6767 E. 28TH PL | 920 | GREASE | |
| NORTHSIDE | 2/21/2005 | S21309 | 2304 N. ELWOOD | 7,095 | ROOT | MANHOLE |
| NORTHSIDE | 3/7/2005 | S21309 | 11327 E. 3RD | 255 | ROOT | MANHOLE |
| NORTHSIDE | 3/9/2005 | S21309 | 18 S. 69TH E. AVE | 7,020 | BROKEN MAIN | PIPE |
| NORTHSIDE | 3/10/2005 | S21309 | 537 S. 108TH E. AVE | | GREASE | MANHOLE |
| NORTHSIDE | 3/10/2005 | S21309 | 603 S. 108TH E. AVE | | GREASE | |
| NORTHSIDE | 3/14/2005 | S21309 | 3218 S. 79TH E. AVE | 2,895 | GREASE | |
| NORTHSIDE | 3/18/2005 | S21309 | 1812 N. YORKTOWN AVE | 624 | ROOT | MANHOLE |
| NORTHSIDE | 3/25/2005 | S21309 | 5114 N. PEORIA AVE | 5,790 | ROOT | MANHOLE |
| NORTHSIDE | 4/2/2005 | S21309 | 1638 E. 68TH ST N. | 21,710 | ROOT | MANHOLE |
| NORTHSIDE | 4/7/2005 | S21309 | 11433 E. 6TH | 360 | BROKEN MAIN | |
| NORTHSIDE | 4/8/2005 | S21309 | E. 28TH ST N. & S. TRENTON AVE | 89,700 | BROKEN MAIN | PIPE |
| NORTHSIDE | 4/8/2005 | S21309 | 7127 E. 9TH | 4,080 | GREASE | MANHOLE |
| NORTHSIDE | 4/12/2005 | S21309 | 4251 N. HARTFORD AVE | 8,190 | DEBRIS | MANHOLE |
| NORTHSIDE | 4/12/2005 | S21309 | 4304 N. IROQUOIS AVE. | | DEBRIS | |
| NORTHSIDE | 5/14/2005 | S21309 | 5928 E. 35 | 255 | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 5/25/2005 | S21309 | 3531 E. VIRGIN ST | 1,200 | GREASE | MANHOLE |
| NORTHSIDE | 5/25/2005 | S21309 | 3508 E. VIRGIN | 200 | GREASE | |
| NORTHSIDE | 5/25/2005 | S21309 | 3504 E. VIRGIN | 200 | GREASE | |
| NORTHSIDE | 5/30/2005 | S21309 | 8205 E. 22 | 480 | GREASE | |
| NORTHSIDE | 6/7/2005 | S21309 | 6537 S. 112TH E. AVE | | ROOTS | |
| NORTHSIDE | 6/11/2005 | S21309 | 8310 E. 65TH PL. | 1,440 | DEBRIS | MANHOLE |
| NORTHSIDE | 6/14/2005 | S21309 | 1811 S. 138TH E. AVE | | GREASE | |
| NORTHSIDE | 6/22/2005 | S21309 | 18515 E. ADMIRAL BL. | 32,504 | EQUIPMENT FAILURE | MANHOLE |
| NORTHSIDE | 6/29/2005 | S21309 | 16318 E. 4TH PL. | 17,952 | EQUIPMENT FAILURE | MANHOLE |
| NORTHSIDE | 7/6/2005 | S21309 | 4829 E. MOHAWK BL. | 13,572 | BROKEN MAIN | PIPE |
| NORTHSIDE | 7/6/2005 | S21309 | 4829 E. MOHAWK BL | 13,572 | BROKEN MAIN | PIPE |
| NORTHSIDE | 7/6/2005 | S21309 | 11626 E. 51 | 7,800 | BROKEN MAIN | PIPE |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 7/8/2005 | S21309 | 5903 E. 35 | 1,911 | GREASE | MANHOLE |
| NORTHSIDE | 7/15/2005 | S21309 | 3753 N. LANSING PL. | 8,160 | ROOTS | MANHOLE |
| NORTHSIDE | 7/15/2005 | S21309 | 3753 N. LANSING PL. | 8,160 | ROOTS | MANHOLE |
| NORTHSIDE | 7/17/2005 | S21309 | 4241 N. IROQUOIS AVE. | | GREASE | |
| NORTHSIDE | 7/17/2005 | S21309 | 4241 N. IROQUOIS AVE | | GREASE | |
| NORTHSIDE | 8/2/2005 | S21309 | 4122 E. MOHAWK BL. | | DEBRIS | |
| NORTHSIDE | 8/5/2005 | S21309 | 6746 S. MEMORIAL DR. | 1,440 | GREASE | MANHOLE |
| NORTHSIDE | 8/9/2005 | S21309 | 6999 S. MEMORIAL DR. | | SCHEDULE CLEANING | |
| NORTHSIDE | 8/11/2005 | S21309 | 12610 E. 23RD | 160 | ROOTS | |
| NORTHSIDE | 8/16/2005 | S21309 | 2500 N. LANSING AVE | 4,720 | GREASE | MANHOLE |
| NORTHSIDE | 8/19/2005 | S21309 | 2523 S. 125TH E. AVE | 1,440 | ROOT | MANHOLE |
| NORTHSIDE | 8/25/2005 | S21309 | 12222 E. 60 | | SCHEDULE CLEANING | |
| NORTHSIDE | 9/23/2005 | S21309 | | | | |
| NORTHSIDE | 9/24/2005 | S21309 | 13103 E. 23 | | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 9/24/2005 | S21309 | 13109 E. 23 | | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 9/24/2005 | S21309 | 13119 E. 23 | 9,650 | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 10/1/2005 | S21309 | 4122 E. MOHAWK BL. | | DEBRIS | |
| NORTHSIDE | 10/5/2005 | S21309 | 1881 S. YALE AVE. | 3,003 | GREASE | MANHOLE |
| NORTHSIDE | 10/11/2005 | S21309 | 4200 S. 129TH E. AVE | 672 | CONSTRUCTION WORK | MANHOLE |
| NORTHSIDE | 10/13/2005 | S21309 | 4122 E. MOHAWK BL. | 5,760 | ROOTS | MANHOLE |
| NORTHSIDE | 11/16/2005 | S21309 | E. PINE ST. & S. 89TH E. AVE | 3,400 | GREASE | MANHOLE |
| NORTHSIDE | 11/16/2005 | S21309 | 8910 E. OKLAHOMA PL. | | GREASE | |
| NORTHSIDE | 11/16/2005 | S21309 | 8906 E. OKLAHOMA PL. | | GREASE | |
| NORTHSIDE | 11/21/2005 | S21309 | 4636 E. 13TH PL. | | DEBRIS | |
| NORTHSIDE | 11/23/2005 | S21309 | 4667 E. INDEPENDENCE | 104 | GREASE | |
| NORTHSIDE | 12/3/2005 | S21309 | 27 E. 62TH PL. | 690 | GREASE | |
| NORTHSIDE | 12/3/2005 | S21309 | 38 E. 62TH PL. | 544 | SCHEDULE CLEANING | MANHOLE |
| NORTHSIDE | 12/11/2005 | S21309 | 12660 E. 31ST CT | | ROOTS | |
| NORTHSIDE | 12/11/2005 | S21309 | 12652 E. 31ST CT | | ROOTS | |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 12/13/2005 | S21309 | 2816 N. BOULDER AVE | | ROOTS | MANHOLE |
| NORTHSIDE | 12/16/2005 | S21309 | 1311 S. LOUISVILLE AVE | | ROOTS | |
| NORTHSIDE | 12/16/2005 | S21309 | 2747 S. 135TH E. AVE | 2,832 | ROOTS | MANHOLE |
| NORTHSIDE | 12/25/2005 | S21309 | 5903 E. 35 | 5,460 | GREASE | MANHOLE |
| NORTHSIDE | 12/27/2005 | S21309 | 11315 E. 4TH PL. | 2,880 | ROOT | |
| NORTHSIDE | 12/27/2005 | S21309 | 7939 E. 59 | | ROOT | MANHOLE |
| NORTHSIDE | 1/4/2006 | S21309 | 10807 E. 36 | | ROOT | |
| NORTHSIDE | 1/4/2006 | S21309 | 10811 E. 36 | | ROOTS | MANHOLE |
| NORTHSIDE | 1/4/2006 | S21309 | 3442 S. 109TH E. AVE | | ROOTS | MANHOLE |
| NORTHSIDE | 1/6/2006 | S21309 | 441 S. GARY AVE | 4,080 | GREASE | MANHOLE |
| NORTHSIDE | 1/6/2006 | S21309 | 9705 E. 5TH PL. | 3,840 | BROKEN MAIN | PIPE |
| NORTHSIDE | 1/7/2006 | S21309 | 51 S. 104TH E. AVE | | GREASE | |
| NORTHSIDE | 1/8/2006 | S21309 | 12429 E. 14 | | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 1/12/2006 | S21309 | 10610 E. 23RD | 408 | ROOTS | |
| NORTHSIDE | 1/16/2006 | S21309 | 7636 E. 21 | | ROOT | |
| NORTHSIDE | 1/16/2006 | S21309 | 7628 E. 21 | | ROOTS | |
| NORTHSIDE | 1/19/2006 | S21309 | 535 E. 53RD ST N. | | ROOTS | |
| NORTHSIDE | 1/25/2006 | S21309 | 6503 E. PINE PL. | | DEBRIS | MANHOLE |
| NORTHSIDE | 1/30/2006 | S21309 | 2921 N. ELGIN AVE | 240 | DEBRIS | |
| NORTHSIDE | 1/31/2006 | S21309 | 1203 N. GRANITE AVE | | CLEANING CREW | |
| NORTHSIDE | 2/1/2006 | S21309 | 12323 E. SKELLY DR. | | CLEANING CREW | |
| NORTHSIDE | 2/5/2006 | S21309 | 7449 E. 68 | | DEBRIS | |
| NORTHSIDE | 2/5/2006 | S21309 | 7445 E. 68 | | DEBRIS | |
| NORTHSIDE | 2/6/2006 | S21309 | 3334 S. 126TH E. AVE | | GREASE | |
| NORTHSIDE | 2/9/2006 | S21309 | 10156 E. ADMIRAL BL. | 1,920 | GREASE | |
| NORTHSIDE | 2/10/2006 | S21309 | 3639 S. 106TH E. PL. | 667 | ROOT | |
| NORTHSIDE | 2/10/2006 | S21309 | 204 N. 193RD E. AVE | 3,840 | CONSTRUCTION WORK | MANHOLE |
| NORTHSIDE | 2/13/2006 | S21309 | 11690 E. 21ST | 5,404 | DEBRIS | MANHOLE |
| NORTHSIDE | 2/24/2006 | S21309 | 408 E. MARSHALL PL. | 9,650 | DEBRIS | MANHOLE |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 2/26/2006 | S21309 | 169 S. 166 E. AVE | 4,676 | GREASE | MANHOLE |
| NORTHSIDE | 2/28/2006 | S21309 | 7856 E. INDEPENDENCE | | VANDALISM | MANHOLE |
| NORTHSIDE | 3/1/2006 | S21309 | 7858 E. INDEPENDENCE | 4,800 | VANDALISM | |
| NORTHSIDE | 3/4/2006 | S21309 | 5837 S. 94TH E. PL. | | GREASE | MANHOLE |
| NORTHSIDE | 3/12/2006 | S21309 | 14023 E. 33 | 17,370 | ROOT | MANHOLE |
| NORTHSIDE | 3/14/2006 | S21309 | 5741 N. GARRISON AVE | 19 | GREASE | |
| NORTHSIDE | 3/16/2006 | S21309 | 12429 E. 14 | 323 | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 3/24/2006 | S21309 | 4518 N. KENOSHA AVE | | GREASE | |
| NORTHSIDE | 3/29/2006 | S21309 | 10307 E. 25TH PL. | | ROOT | MANHOLE |
| NORTHSIDE | 4/15/2006 | S21309 | 2312 N. WHEELING AVE. | 63,990 | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 4/17/2006 | S21309 | 5335 E. 26TH | | ROOTS | |
| NORTHSIDE | 4/22/2006 | S21309 | 16711 E. ADMIRAL PL. | 4,095 | DEBRIS | MANHOLE |
| NORTHSIDE | 4/27/2006 | S21309 | 7454 E. 41 | 8,640 | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 4/30/2006 | S21309 | 1722 S. LOUISVILLE AVE | 1,617 | ROOTS | |
| NORTHSIDE | 4/30/2006 | S21309 | 4302 E. PINE | 30,060 | DEBRIS | MANHOLE |
| NORTHSIDE | 4/30/2006 | S21309 | 1728 S. LOUISVILLE AVE | 1,617 | ROOT | |
| NORTHSIDE | 5/1/2006 | S21309 | 7454 E. 41ST | 4,624 | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 5/4/2006 | S21309 | 3300 S. 116TH E. AVE | 211,914 | RAIN | MANHOLE |
| NORTHSIDE | 5/4/2006 | S21309 | 2624 N. CINCINNATI AVE. | 150 | RAIN | |
| NORTHSIDE | 5/9/2006 | S21309 | 10711 E. 16TH PL. | 3,944 | GREASE | MANHOLE |
| NORTHSIDE | 5/15/2006 | S21309 | 38 E. 49TH PL. N. | | GREASE | |
| NORTHSIDE | 6/6/2006 | S21309 | 4161 E. ADMIRAL PL. | 18,360 | VANDALISM | MANHOLE |
| NORTHSIDE | 6/6/2006 | S21309 | 806 N. URBANIA AVE | 18 | | |
| NORTHSIDE | 6/6/2006 | S21309 | 806 N. URBANA AVE. | 18,360 | VANDALISM | MANHOLE |
| NORTHSIDE | 6/10/2006 | S21309 | 1548 S. JAMESTOWN AVE. | 299 | DEBRIS | |
| NORTHSIDE | 6/17/2006 | S21309 | 10115 E. 24TH PL. | 3,667 | GREASE | MANHOLE |
| NORTHSIDE | 6/17/2006 | S21309 | PLANT | | POWER OUTAGE | |
| NORTHSIDE | 6/21/2006 | S21309 | 10151 E. 11TH | 4,832 | BROKEN MAIN | PIPE |
| NORTHSIDE | 6/22/2006 | S21309 | 1320 S. INDIANAPOLIS AVE. | | RAIN | |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 6/22/2006 | S21309 | 5410 E. 11TH | | ROOT | |
| NORTHSIDE | 6/22/2006 | S21309 | | | | |
| NORTHSIDE | 7/5/2006 | S21309 | 832 N. LOUISVILLE AVE. | 29 | BROKEN MAIN | |
| NORTHSIDE | 7/12/2006 | S21309 | 2624 N. CINCINNATI AVE. | | RAIN | |
| NORTHSIDE | 7/31/2006 | S21309 | 253 S. 163RD E. AVE. | 1,035 | ROOT | |
| NORTHSIDE | 8/10/2006 | S21309 | 5085 S. 76TH E. AVE | 720 | GREASE | MANHOLE |
| NORTHSIDE | 8/10/2006 | S21309 | 10170 E. 22 | | DEBRIS | |
| NORTHSIDE | 8/30/2006 | S21309 | | | ROOTS | |
| NORTHSIDE | 8/31/2006 | S21309 | 3509 E. 11TH | | DEBRIS | |
| NORTHSIDE | 9/5/2006 | S21309 | 1925 N. SHERIDAN RD. | 84 | DEBRIS | |
| NORTHSIDE | 9/21/2006 | S21309 | 10976 E. 3RD | | DEBRIS | |
| NORTHSIDE | 10/5/2006 | S21309 | 2512 N. GARRISON PL. | 40 | GREASE | |
| NORTHSIDE | 10/16/2006 | S21309 | 2243 N. BIRMINGHAM PL. | 2,895 | GREASE | MANHOLE |
| NORTHSIDE | 10/23/2006 | S21309 | 2868 E. ADMIRAL PL. | 1,152 | GREASE | MANHOLE |
| NORTHSIDE | 10/23/2006 | S21309 | 20 N. COLLEGE AVE. | | GREASE | |
| NORTHSIDE | 11/6/2006 | S21309 | 1634 E. PINE ST. | | BROKEN MAIN | |
| NORTHSIDE | 11/6/2006 | S21309 | 10703 E. 16TH PL. | 22,570 | GREASE | MANHOLE |
| NORTHSIDE | 11/7/2006 | S21309 | 1634 E. PINE ST. | | BROKEN MAIN | |
| NORTHSIDE | 11/7/2006 | S21309 | 1634 E. PINE | 928 | BROKEN MAIN | PIPE |
| NORTHSIDE | 11/9/2006 | S21309 | 8110 E. 65TH PL. | 6,120 | GREASE | MANHOLE |
| NORTHSIDE | 11/13/2006 | S21309 | 1319 W. WOODROW ST. | 2,171 | GREASE | MANHOLE |
| NORTHSIDE | 11/15/2006 | S21309 | 2418 N. NORWOOD PL. | | ROOT | MANHOLE |
| NORTHSIDE | 11/15/2006 | S21309 | 2404 N. NORWOOD PL. | | ROOT | MANHOLE |
| NORTHSIDE | 11/20/2006 | S21309 | 2716 E. ARCHER | | ROOTS | |
| NORTHSIDE | 11/23/2006 | S21309 | 10728 E. SKELLY DR. | | DEBRIS | |
| NORTHSIDE | 11/27/2006 | S21309 | 3827 E. WOODROW ST | | ROOTS | |
| NORTHSIDE | 11/29/2006 | S21309 | 6308 E. VIRGIN ST. | 1,920 | GREASE | MANHOLE |
| NORTHSIDE | 12/6/2006 | S21309 | 2102 N. VANCOUVER AVE. | 1,904 | CLEANING CREW | MANHOLE |
| NORTHSIDE | 12/6/2006 | S21309 | 2140 N. WACO AVE | 672 | GREASE | MANHOLE |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 12/7/2006 | S21309 | 11107 E.34 | 1,872 | ROOTS | MANHOLE |
| NORTHSIDE | 12/15/2006 | S21309 | 2201 E. READING ST. | 170 | GREASE | MANHOLE |
| NORTHSIDE | 12/19/2006 | S21309 | 1448 N. DELAWARE PL. | | GREASE | |
| NORTHSIDE | 12/20/2006 | S21309 | 3542 E. VIRGIN PL. | 1,092 | ROOTS | |
| NORTHSIDE | 12/21/2006 | S21309 | 2624 N. CINCINNATI | 360 | ROOT | |
| NORTHSIDE | 12/22/2006 | S21309 | 1438 N. SANTA FE | | GREASE | |
| NORTHSIDE | 12/25/2006 | S21309 | 9739 E. 12 | 672 | GREASE | MANHOLE |
| NORTHSIDE | 12/30/2006 | S21309 | 4160 E. 1ST | 472 | DEBRIS | |
| NORTHSIDE | 12/30/2006 | S21309 | 2460 N. BOSTON PL. | 120 | GREASE | |
| NORTHSIDE | 12/30/2006 | S21309 | 10156 E. ADMIRAL BL. | 112 | GREASE | |
| NORTHSIDE | 1/1/2007 | S21309 | 6323 E. 5TH | | CLEANONG CREW | |
| NORTHSIDE | 1/2/2007 | S21309 | 511 W. NEWTON | 672 | VANDALISM | MANHOLE |
| NORTHSIDE | 1/2/2007 | S21309 | 10156 E. ADMIRAL BL. | 240 | GREASE | |
| NORTHSIDE | 1/7/2007 | S21309 | 2446 S. 140TH E. AVE | | GREASE | |
| NORTHSIDE | 1/7/2007 | S21309 | 2446 S. 140TH E. AVE | 448 | GREASE | |
| NORTHSIDE | 1/7/2007 | S21309 | 2439 S. 139TH E. AVE | | GREASE | |
| NORTHSIDE | 1/8/2007 | S21309 | 2428 S. 140TH E. AVE | | GREASE | |
| NORTHSIDE | 1/8/2007 | S21309 | 13106 E. 30TH | 97 | GREASE | |
| NORTHSIDE | 1/8/2007 | S21309 | 2413 S. 139TH E. AVE | 2,312 | GREASE | MANHOLE |
| NORTHSIDE | 1/8/2007 | S21309 | 2428 S. 140TH E. AVE | 920 | GREASE | |
| NORTHSIDE | 1/9/2007 | S21309 | 6309 E. 4TH PL. | 200 | DEBRIS | MANHOLE |
| NORTHSIDE | 1/18/2007 | S21309 | 13326 E. 33RD PL. | 472 | ROOTS | |
| NORTHSIDE | 1/22/2007 | S21309 | 2304 N. ELWOOD AVE. | 1,440 | DEBRIS | MANHOLE |
| NORTHSIDE | 1/22/2007 | S21309 | 2303 N. OSAGE DR. | | DEBRIS | |
| NORTHSIDE | 1/25/2007 | S21309 | 1817 S. 143RD E. AVE | 1,632 | ROOTS | MANHOLE |
| NORTHSIDE | 1/31/2007 | S21309 | 1340 N. BOSTON AVE. | 808 | GREASE | |
| NORTHSIDE | 1/31/2007 | S21309 | 1347 N. MAIN ST. | 419 | GREASE | |
| NORTHSIDE | 2/3/2007 | S21309 | 228 S. 184TH E. AVE | | GREASE | |
| NORTHSIDE | 2/3/2007 | S21309 | 312 S. 117TH E. PL. | | ROOT | |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 2/3/2007 | S21309 | 11706 E. 3RD | | ROOTS | MANHOLE |
| NORTHSIDE | 2/6/2007 | S21309 | 5151 S. 110TH E. AVE | | CLEANING CREW | |
| NORTHSIDE | 2/18/2007 | S21309 | 650 S. MEMORIAL DR. | 336 | DEBRIS | |
| NORTHSIDE | 2/18/2007 | S21309 | 8010 E. 6TH | 672 | DEBRIS | MANHOLE |
| NORTHSIDE | 2/18/2007 | S21309 | 11126 E. 36TH | | ROOT | |
| NORTHSIDE | 2/20/2007 | S21309 | 2440 N. BOSTON PL. | 4,488 | GREASE | |
| NORTHSIDE | 2/22/2007 | S21309 | 5223 E. 46TH ST. N. | 80,280 | EQUIPMENT FAILURE | MANHOLE |
| NORTHSIDE | 2/23/2007 | S21309 | 1420 N. OSAGE DR. | 3,944 | DEBRIS | MANHOLE |
| NORTHSIDE | 2/24/2007 | S21309 | 12780 E. 39 | | GREASE | |
| NORTHSIDE | 2/24/2007 | S21309 | 12778 E. 39 | 345 | GREASE | |
| NORTHSIDE | 2/24/2007 | S21309 | 12780 E. 39 | 345 | GREASE | |
| NORTHSIDE | 2/24/2007 | S21309 | 12778 E. 39 | | GREASE | |
| NORTHSIDE | 2/26/2007 | S21309 | 3753 N. LANSING PL. | 2,360 | ROOTS | MANHOLE |
| NORTHSIDE | 3/2/2007 | S21309 | 10715 E. 26TH PL. | 112 | ROOTS | |
| NORTHSIDE | 3/10/2007 | S21309 | 9919 E. 28TH PL. | | GREASE | MANHOLE |
| NORTHSIDE | 3/19/2007 | S21309 | 9126 E. 17TH | 80 | GREASE | |
| NORTHSIDE | 3/23/2007 | S21309 | 502 E. 36TH ST. N. | 1,946 | GREASE | MANHOLE |
| NORTHSIDE | 3/24/2007 | S21309 | 7460 E. 3RD | 120 | DEBRIS | |
| NORTHSIDE | 3/27/2007 | S21309 | 2807 N. KINGSTON AVE | | SCHEDULE CLEANING | |
| NORTHSIDE | 3/27/2007 | S21309 | 3911 S. 125TH E. AVE. | 160 | ROOT | |
| NORTHSIDE | 3/31/2007 | S21309 | 1412 S. 76TH E. AVE | | ROOT | |
| NORTHSIDE | 4/2/2007 | S21309 | 10858 E. 33 | | ROOTS | |
| NORTHSIDE | 4/2/2007 | S21309 | 12102 E. 26 | 2,720 | ROOT | MANHOLE |
| NORTHSIDE | 4/2/2007 | S21309 | 426 S. ZURICH | | BROKEN MAIN | |
| NORTHSIDE | 4/11/2007 | S21309 | 1705 S. 74TH E. AVE | 80 | DEBRIS | |
| NORTHSIDE | 4/15/2007 | S21309 | 2624 E. NEWTON | 480 | GREASE | MANHOLE |
| NORTHSIDE | 4/20/2007 | S21309 | 7313 E. NEWTON | | GREASE | |
| NORTHSIDE | 4/23/2007 | S21309 | 1805 N. XENOPHON AVE. | 2,340 | BROKEN MAIN | PIPE |
| NORTHSIDE | 4/26/2007 | S21309 | 9719 E. 4TH | 480 | GREASE | MANHOLE |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 4/26/2007 | S21309 | 9720 E. 3RD | | GREASE | |
| NORTHSIDE | 4/27/2007 | S21309 | 7703 E. KING ST. | 232 | BROKEN MAIN | |
| NORTHSIDE | 4/27/2007 | S21309 | 2755 S. 114TH E. AVE | | ROOT | |
| NORTHSIDE | 4/28/2007 | S21309 | 7703 E. KING | 232 | BROKEN MAIN | |
| NORTHSIDE | 5/2/2007 | S21309 | 4011 N. GARRISON AVE. | 43,200 | RAIN | MANHOLE |
| NORTHSIDE | 5/3/2007 | S21309 | 5724 E. TECUMSEH ST. | 79,937 | RAIN | MANHOLE |
| NORTHSIDE | 5/3/2007 | S21309 | 812 N. OSWEGO AVE | 69,615 | RAIN | MANHOLE |
| NORTHSIDE | 5/3/2007 | S21309 | 5751 E. 4TH PL. | 24,570 | RAIN | MANHOLE |
| NORTHSIDE | 5/3/2007 | S21309 | 2624 N. CINCINNATTI | 20,475 | RAIN | |
| NORTHSIDE | 5/3/2007 | S21309 | 5751 E. 4TH PL. | 66,612 | RAIN | MANHOLE |
| NORTHSIDE | 5/3/2007 | S21309 | 5810 E. TECUMSEH ST. | 79,937 | RAIN | MANHOLE |
| NORTHSIDE | 5/3/2007 | S21309 | 5811 E. TECUMSEH | 65,234 | RAIN | MANHOLE |
| NORTHSIDE | 5/3/2007 | S21309 | 1540 N. YALE AVE | 64,155 | RAIN | MANHOLE |
| NORTHSIDE | 5/3/2007 | S21309 | 5116 E. PINE | 24,544 | RAIN | MANHOLE |
| NORTHSIDE | 5/3/2007 | S21309 | 5820 E. 15TH | 72,345 | RAIN | MANHOLE |
| NORTHSIDE | 5/3/2007 | S21309 | 6051 E. PINE | | RAIN | |
| NORTHSIDE | 5/3/2007 | S21309 | 1157 N. COLLEGE AVE. | 213,760 | RAIN | MANHOLE |
| NORTHSIDE | 5/3/2007 | S21309 | 1411 N. ROSEDALE AVE | 3,887 | RAIN | |
| NORTHSIDE | 5/3/2007 | S21309 | 6932 E. NEWTON PL. | | GREASE | |
| NORTHSIDE | 5/3/2007 | S21309 | 6938 E. NEWTON PL. | | GREASE | |
| NORTHSIDE | 5/3/2007 | S21309 | 6930 E. NEWTON PL. | | RAIN | |
| NORTHSIDE | 5/3/2007 | S21309 | 3924 N. LANSING AVE. | 78,165 | RAIN | MANHOLE |
| NORTHSIDE | 5/3/2007 | S21309 | 5742 E. 4TH PL. | 8,510 | RAIN | |
| NORTHSIDE | 5/3/2007 | S21309 | 5012 E. PINE | 20,072 | RAIN | MANHOLE |
| NORTHSIDE | 5/7/2007 | S21309 | 203 S. QUEBEC AVE | 41,232 | RAIN | MANHOLE |
| NORTHSIDE | 5/7/2007 | S21309 | 2733 S. IRVINGTON AVE. | 50,640 | RAIN | MANHOLE |
| NORTHSIDE | 5/7/2007 | S21309 | 8934 E. LATIMER | | RAIN | |
| NORTHSIDE | 5/7/2007 | S21309 | 1518 N. MAPLEWOOD AVE. | | RAIN | |
| NORTHSIDE | 5/7/2007 | S21309 | 3526 E. 5TH PL. | 324,240 | RAIN | MANHOLE |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 5/7/2007 | S21309 | 1102 S. YALE AVE. | | RAIN | |
| NORTHSIDE | 5/7/2007 | S21309 | 812 N. OSWEGO AVE. | 392,315 | RAIN | MANHOLE |
| NORTHSIDE | 5/7/2007 | S21309 | 801 N. MINGO RD. | 796,590 | RAIN | MANHOLE |
| NORTHSIDE | 5/8/2007 | S21309 | 102 S. 91ST E. AVE | | RAIN | MANHOLE |
| NORTHSIDE | 5/8/2007 | S21309 | 12237 E. 38TH | | GREASE | |
| NORTHSIDE | 5/8/2007 | S21309 | 2624 N. CINCINNATI | | RAIN | MANHOLE |
| NORTHSIDE | 5/8/2007 | S21309 | 12231 E. 38TH | 100 | GREASE | |
| NORTHSIDE | 5/8/2007 | S21309 | 727 E. 56TH ST N. | 110,010 | RAIN | MANHOLE |
| NORTHSIDE | 5/8/2007 | S21309 | 3600 N. LEWIS AVE | | UNKNOWN | MANHOLE |
| NORTHSIDE | 5/8/2007 | S21309 | 2715 E. 28TH | | RAIN | MANHOLE |
| NORTHSIDE | 5/8/2007 | S21309 | 2738 S. HUDSON PL. | | RAIN | MANHOLE |
| NORTHSIDE | 5/8/2007 | S21309 | MINGO | | RAIN | |
| NORTHSIDE | 5/9/2007 | S21309 | 5504 E. 4TH PL | 2,250 | BROKEN MAIN | |
| NORTHSIDE | 5/9/2007 | S21309 | 1507 N. MAIN ST. | 6,440 | RAIN | |
| NORTHSIDE | 5/10/2007 | S21309 | 1413 N. 94TH E. AVE | | RAIN | MANHOLE |
| NORTHSIDE | 5/10/2007 | S21309 | 5724 E. TECUMSEH | 450,900 | RAIN | MANHOLE |
| NORTHSIDE | 5/10/2007 | S21309 | 5810 E. TECUMSEH | 638,550 | RAIN | MANHOLE |
| NORTHSIDE | 5/10/2007 | S21309 | 5811 E. TECUMSEH | 638,550 | RAIN | MANHOLE |
| NORTHSIDE | 5/15/2007 | S21309 | E. 61ST ST & S. 129TH E. AVE | | DEBRIS | MANHOLE |
| NORTHSIDE | 5/16/2007 | S21309 | 8918 E. 60TH | 40,677 | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 5/16/2007 | S21309 | 8922 E. 60TH | | BROKEN MAIN | |
| NORTHSIDE | 5/16/2007 | S21309 | 8918 E. 60TH | | BROKEN MAIN | |
| NORTHSIDE | 5/16/2007 | S21309 | 2727 S. 104TH E. AVE | | GREASE | |
| NORTHSIDE | 5/16/2007 | S21309 | 2807 S. 104TH E. AVE | 672 | GREASE | MANHOLE |
| NORTHSIDE | 5/16/2007 | S21309 | 2727 S. 104TH E. AVE | | GREASE | |
| NORTHSIDE | 5/16/2007 | S21309 | 204 S. 69TH E. AVE | 480 | DEBRIS | |
| NORTHSIDE | 5/16/2007 | S21309 | 8918 E. 60TH | 40,677 | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 5/16/2007 | S21309 | 8928 E. 60TH | 2,702 | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 5/24/2007 | S21309 | 1507 N. MAIN ST. | 48,700 | BROKEN MAIN | |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 6/1/2007 | S21309 | 7837 E. 51ST | | BROKEN MAIN | |
| NORTHSIDE | 6/1/2007 | S21309 | 5058 S. 75TH E. AVE | 3,600 | BROKEN MAIN | |
| NORTHSIDE | 6/1/2007 | S21309 | 7837 E. 51ST | | BROKEN MAIN | |
| NORTHSIDE | 6/1/2007 | S21309 | 5058 S. 75TH E. AVE | 92 | BROKEN MAIN | |
| NORTHSIDE | 6/6/2007 | S21309 | 8964 E. OKLAHOMA PL. | 80 | GREASE | |
| NORTHSIDE | 6/12/2007 | S21309 | 5820 E. 15 | | RAIN | MANHOLE |
| NORTHSIDE | 6/12/2007 | S21309 | 4631 E. 2ND | | RAIN | MANHOLE |
| NORTHSIDE | 6/12/2007 | S21309 | 3622 E. 15TH | 4,862 | RAIN | |
| NORTHSIDE | 6/12/2007 | S21309 | 4920 E. 7TH | | RAIN | |
| NORTHSIDE | 6/12/2007 | S21309 | 1208 S. FLORENCE PL. | | RAIN | |
| NORTHSIDE | 6/12/2007 | S21309 | 5805 E. 15 | | RAIN | MANHOLE |
| NORTHSIDE | 6/20/2007 | S21309 | 1411 N. ROSEDALE AVE. | | RAIN | |
| NORTHSIDE | 6/21/2007 | S21309 | 2169 S. 104TH E. AVE | 10,808 | GREASE | MANHOLE |
| NORTHSIDE | 6/23/2007 | S21309 | 11815 E. 16TH | 88 | GREASE | |
| NORTHSIDE | 6/25/2007 | S21309 | 1700 S. YALE AVE | | DEBRIS | MANHOLE |
| NORTHSIDE | 6/27/2007 | S21309 | 2511 S. 124TH E. AVE | | ROOT | |
| NORTHSIDE | 6/27/2007 | S21309 | 2624 N. CINCINNATI | | RAIN | |
| NORTHSIDE | 6/27/2007 | S21309 | 1802 N. TRENTON AVE | | GREASE | |
| NORTHSIDE | 6/27/2007 | S21309 | 5742 E. 4TH PL. | 63,784 | RAIN | |
| NORTHSIDE | 6/27/2007 | S21309 | 5715 E. 28 | | ROOT | |
| NORTHSIDE | 6/27/2007 | S21309 | 2738 S. HUDSON PL. | | ROOT | MANHOLE |
| NORTHSIDE | 6/27/2007 | S21309 | 1447 S. ERIE | 121,576 | RAIN | MANHOLE |
| NORTHSIDE | 6/27/2007 | S21309 | 5820 E. 15 | 837,581 | RAIN | MANHOLE |
| NORTHSIDE | 6/27/2007 | S21309 | 3622 E. 15TH | | RAIN | |
| NORTHSIDE | 6/27/2007 | S21309 | 1411 N. ROSEDALE AVE | | RAIN | |
| NORTHSIDE | 6/27/2007 | S21309 | 4631 E. 2 | | RAIN | MANHOLE |
| NORTHSIDE | 6/27/2007 | S21309 | 5751 E. 4TH PL. | 136,065 | RAIN | MANHOLE |
| NORTHSIDE | 6/27/2007 | S21309 | 5727 E. 4TH PL. | 23,600 | RAIN | |
| NORTHSIDE | 6/28/2007 | S21309 | 4216 N. LEWIS | 388,333 | RAIN | MANHOLE |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 6/28/2007 | S21309 | 1411 N. ROSEDALE | | RAIN | |
| NORTHSIDE | 6/28/2007 | S21309 | 5805 E. 15TH | 44,688 | RAIN | MANHOLE |
| NORTHSIDE | 6/28/2007 | S21309 | 727 N. BIRMINGHAM AVE | | BROKEN MAIN | |
| NORTHSIDE | 6/28/2007 | S21309 | 5820 E. 15TH | 315,964 | RAIN | MANHOLE |
| NORTHSIDE | 6/28/2007 | S21309 | 102 S. 91ST E. AVE | | RAIN | |
| NORTHSIDE | 6/28/2007 | S21309 | 1952 E. OKLAHOMA | 286,377 | RAIN | MANHOLE |
| NORTHSIDE | 6/28/2007 | S21309 | 1447 S. ERIE | 312,958 | RAIN | MANHOLE |
| NORTHSIDE | 7/2/2007 | S21309 | 1411 N. ROSEDALE AVE. | | RAIN | |
| NORTHSIDE | 7/5/2007 | S21309 | 5751 E. 4TH PL. | | ROOT | MANHOLE |
| NORTHSIDE | 7/5/2007 | S21309 | 5727 E. 4TH PL. | | ROOT | |
| NORTHSIDE | 7/15/2007 | S21309 | 6323 S. 109TH E. AVE | | ROOT | |
| NORTHSIDE | 7/16/2007 | S21309 | 11906 E. 7TH | 1,440 | DEBRIS | MANHOLE |
| NORTHSIDE | 7/20/2007 | S21309 | 11054 E. 15TH PL. | 1,680 | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 7/21/2007 | S21309 | 3218 S. KINGSTON AVE. | 67,456 | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 7/21/2007 | S21309 | 3217 S. KINGSTON AVE. | | EQUIPMENT FAILURE | |
| NORTHSIDE | 7/25/2007 | S21309 | 3218 S. KINGDON AVE | 2,880 | EQUIPMENT FAILURE | MANHOLE |
| NORTHSIDE | 8/8/2007 | S21309 | 2803 E. 1ST | 6,528 | VANDALISM | MANHOLE |
| NORTHSIDE | 8/8/2007 | S21309 | 2748 E. ADMIRAL BL. | 6,528 | VANDALISM | MANHOLE |
| NORTHSIDE | 8/20/2007 | S21309 | 4423 N. DETROIT PL. | 248 | GREASE | |
| NORTHSIDE | 8/20/2007 | S21309 | 4554 N. IROQUOIS AVE. | | GREASE | |
| NORTHSIDE | 8/27/2007 | S21309 | 4916 N. TRENTON AVE. | 8,190 | ROOT | MANHOLE |
| NORTHSIDE | 8/30/2007 | S21309 | 1411 N. ROSEDALE AVE. | | UNKNOWN | |
| NORTHSIDE | 9/1/2007 | S21309 | 4809 N. XANTHUS AVE. | 960 | ROOT | MANHOLE |
| NORTHSIDE | 9/8/2007 | S21309 | 1235 S. OSWEGO AVE. | | RAIN | |
| NORTHSIDE | 9/8/2007 | S21309 | 1603 S. FLORENCE AVE | | RAIN | |
| NORTHSIDE | 9/8/2007 | S21309 | 1110 S. YALE AVE | | RAIN | |
| NORTHSIDE | 9/8/2007 | S21309 | 1147 S. GARY PL. | | RAIN | |
| NORTHSIDE | 9/8/2007 | S21309 | 1143 S. GARY PL. | | RAIN | |
| NORTHSIDE | 9/8/2007 | S21309 | 1217 S. OSWEGO AVE | | RAIN | |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 9/8/2007 | S21309 | 102 S. 91ST E. AVE | | RAIN | |
| NORTHSIDE | 9/8/2007 | S21309 | 1810 E. 11TH | | RAIN | |
| NORTHSIDE | 9/9/2007 | S21309 | 1411 N. ROSEDALE | | RAIN | |
| NORTHSIDE | 9/9/2007 | S21309 | 13372 E. 32ND PL. | 5,010 | GREASE | MANHOLE |
| NORTHSIDE | 9/10/2007 | S21309 | 4935 E. 4TH | | RAIN | MANHOLE |
| NORTHSIDE | 9/12/2007 | S21309 | 3622 E. 15 | | UNKNOWN | |
| NORTHSIDE | 9/13/2007 | S21309 | 1113 S. GARY PL. | | UNKNOWN | |
| NORTHSIDE | 9/15/2007 | S21309 | 1355 N. 77TH E. AVE | | UNKNOWN | MANHOLE |
| NORTHSIDE | 9/19/2007 | S21309 | 12516 E. 39TH PL. | | GREASE | |
| NORTHSIDE | 9/28/2007 | S21309 | 437 S. 71ST. E. AVE | | CLEANING CREW | |
| NORTHSIDE | 9/28/2007 | S21309 | 403 S. 71ST E. AVE | | CLEANING CREW | |
| NORTHSIDE | 9/28/2007 | S21309 | 414 S. 72ND E. AVE | | CLEANING CREW | |
| NORTHSIDE | 9/28/2007 | S21309 | 418 S. 72ND E. AVE | | CLEANING CREW | |
| NORTHSIDE | 9/28/2007 | S21309 | 409 S. 71ST E. AVE | | CLEANING CREW | |
| NORTHSIDE | 10/1/2007 | S21309 | 6761 E. JASPER | 38,080 | ROOT | MANHOLE |
| NORTHSIDE | 10/1/2007 | S21309 | 6747 E. JASPER ST. | 33,728 | ROOT | |
| NORTHSIDE | 10/12/2007 | S21309 | 1362 E. 54TH ST N. | | GREASE | |
| NORTHSIDE | 10/12/2007 | S21309 | 442 S. JAMESTOWN AVE | 3,648 | ROOTS | MANHOLE |
| NORTHSIDE | 10/12/2007 | S21309 | 4343 S. 109TH E. AVE | 368 | GREASE | |
| NORTHSIDE | 10/15/2007 | S21309 | 6111 E. 32ND PL. | 425 | BROKEN MAIN | |
| NORTHSIDE | 10/22/2007 | S21309 | 6111 E. 32ND PL. | | BROKEN MAIN | |
| NORTHSIDE | 11/2/2007 | S21309 | 453 S. 68TH E. AVE | | CLEANING CREW | |
| NORTHSIDE | 11/7/2007 | S21309 | 7609 E. 21ST PL | 1,225 | GREASE | MANHOLE |
| NORTHSIDE | 11/14/2007 | S21309 | 10531 E. 6TH | 368 | DEBRIS | |
| NORTHSIDE | 11/27/2007 | S21309 | 16455 E. 1ST | | ROOTS | |
| NORTHSIDE | 11/28/2007 | S21309 | 3409 S. 119TH E. AVE | 1,488 | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 11/29/2007 | S21309 | 1111 S. SHERIDAN RD. | 3,350 | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 12/1/2007 | S21309 | 3901 S. 130TH E. PL | 1,488 | ROOT | MANHOLE |
| NORTHSIDE | 12/11/2007 | S21309 | 7598 N. TRENTON AVE | 159,225 | POWER FAILURE | MANHOLE |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 12/11/2007 | S21309 | 1518 E. 76TH ST. N | 159,225 | POWER FAILURE | MANHOLE |
| NORTHSIDE | 12/11/2007 | S21309 | 7600 N. TRENTON AVE. | 274,365 | POWER FAILURE | MANHOLE |
| NORTHSIDE | 12/12/2007 | S21309 | 20550 E. 4TH | 1,440 | POWER FAILURE | LIFT STATION |
| NORTHSIDE | 12/12/2007 | S21309 | 20550 E. 4TH | 1,440 | POWER LOSS | LIFT STATION |
| NORTHSIDE | 12/13/2007 | S21309 | 7617 E. 66TH | | ROOT | |
| NORTHSIDE | 12/20/2007 | S21309 | 6508 S. 93RD E. AVE | | VANDALISM | |
| NORTHSIDE | 12/26/2007 | S21309 | 2455 E. 36TH ST. N. | 14,457 | ROOTS | MANHOLE |
| NORTHSIDE | 12/26/2007 | S21309 | 5763 E. 31ST | | ROOTS | MANHOLE |
| NORTHSIDE | 12/30/2007 | S21309 | 12449 E. 13TH PL. | | GREASE | |
| NORTHSIDE | 12/31/2007 | S21309 | 1411 N. ROSEDALE AVE | | UNKNOWN | |
| NORTHSIDE | 1/2/2008 | S21309 | 12335 E. 13TH PL. | 11,580 | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 1/2/2008 | S21309 | 12331 E. 13TH PL. | | BROKEN MAIN | |
| NORTHSIDE | 1/2/2008 | S21309 | 2708 N. KENOSHA AVE. | | DEBRIS | |
| NORTHSIDE | 1/7/2008 | S21309 | 5035 N. BOSTON PL. | | BROKEN MAIN | PIPE |
| NORTHSIDE | 1/7/2008 | S21309 | 2129 N. VANCOUVER AVE. | 9,650 | ROOT | MANHOLE |
| NORTHSIDE | 1/12/2008 | S21309 | 16417 E. 1ST PL. | | BROKEN MAIN | |
| NORTHSIDE | 1/18/2008 | S21309 | 11646 E. 36TH | | GREASE | |
| NORTHSIDE | 1/18/2008 | S21309 | 3608 S. 118TH E. AVE | | GREASE | |
| NORTHSIDE | 1/23/2008 | S21309 | 2854 E. 42ND ST N. | | ROOT | |
| NORTHSIDE | 1/25/2008 | S21309 | 760 E. 34TH ST. N | | ROOT | |
| NORTHSIDE | 1/27/2008 | S21309 | 1411 N. ROSEDALE AVE | | UNKNOWN | |
| NORTHSIDE | 1/29/2008 | S21309 | 5371 E. 30TH | 289 | DEBRIS | MANHOLE |
| NORTHSIDE | 1/29/2008 | S21309 | 1411 N. ROSEDALE AVE | | UNKNOWN | |
| NORTHSIDE | 1/30/2008 | S21309 | 236 N. 181ST E. AVE | 2,040 | GREASE | MANHOLE |
| NORTHSIDE | 2/1/2008 | S21309 | 2443 S. JOPLIN AVE. | 2,176 | DEBRIS | MANHOLE |
| NORTHSIDE | 2/2/2008 | S21309 | 13002 E. 46TH | 3,648 | GREASE | MANHOLE |
| NORTHSIDE | 2/4/2008 | S21309 | 4371 N. ELGIN AVE | 527 | ROOTS | |
| NORTHSIDE | 2/5/2008 | S21309 | 1500 N. YUKON AVE. | 35,948 | ROOT | MANHOLE |
| NORTHSIDE | 2/12/2008 | S21309 | 3764 N. HARTFORD AVE. | 690 | ROOT | |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 2/15/2008 | S21309 | 341 E. XYLER ST. | 480 | GREASE | |
| NORTHSIDE | 2/17/2008 | S21309 | 7128 E. 8TH ST | | GREASE | |
| NORTHSIDE | 2/17/2008 | S21309 | 618 E. XYLER ST. | | GREASE | |
| NORTHSIDE | 2/17/2008 | S21309 | 622 E. XYLER ST. | 345 | GREASE | |
| NORTHSIDE | 2/18/2008 | S21309 | 7835 E. 3RD | 280 | BROKEN MAIN | |
| NORTHSIDE | 2/18/2008 | S21309 | 1424 S. 75TH E. AVE | | DEBRIS | |
| NORTHSIDE | 2/18/2008 | S21309 | 7128 E. 8TH | | DEBRIS | |
| NORTHSIDE | 2/19/2008 | S21309 | 5908 N. ELGIN AVE | 14,976 | VANDALISM | |
| NORTHSIDE | 2/27/2008 | S21309 | 1527 S. GARY AVE. | | DEBRIS | |
| NORTHSIDE | 2/27/2008 | S21309 | 1536 S. GARY AVE | | DEBRIS | |
| NORTHSIDE | 3/3/2008 | S21309 | E. 66TH ST. & S. 101 E. AVE | | DEFECTIVE MANHOLE | MANHOLE |
| NORTHSIDE | 3/18/2008 | S21309 | 5981 E. 27TH | 26,640 | RAIN | MANHOLE |
| NORTHSIDE | 3/18/2008 | S21309 | 1521 N. MAPLEWOOD AVE | 55,005 | RAIN | MANHOLE |
| NORTHSIDE | 3/18/2008 | S21309 | 5811 E. TECUMSEH | 73,710 | RAIN | MANHOLE |
| NORTHSIDE | 3/18/2008 | S21309 | 5810 E. TECUMSEH | 73,710 | RAIN | MANHOLE |
| NORTHSIDE | 3/18/2008 | S21309 | 1419 N. 94TH E. AVE | 46,560 | RAIN | |
| NORTHSIDE | 3/18/2008 | S21309 | 1413 N. 94TH E. AVE | 92,640 | RAIN | MANHOLE |
| NORTHSIDE | 3/18/2008 | S21309 | 1447 S. ERIE | 123,246 | RAIN | MANHOLE |
| NORTHSIDE | 3/18/2008 | S21309 | 5519 E. 15TH | 138,240 | RAIN | MANHOLE |
| NORTHSIDE | 3/18/2008 | S21309 | 5820 E. 15TH | > 2,000,000 | RAIN | MANHOLE |
| NORTHSIDE | 3/18/2008 | S21309 | 1930 N. BIRMINGHAM AVE | 2,400 | GREASE | MANHOLE |
| NORTHSIDE | 3/18/2008 | S21309 | LOWER BIRD CREEK | 275,000 | RAINS | HEAD WORKS |
| NORTHSIDE | 3/18/2008 | S21309 | E. APACHE ST. & N. LANSING | 9,930 | GREASE | MANHOLE |
| NORTHSIDE | 3/18/2008 | S21309 | 2950 N. GILLETTE | 14 | GREASE | |
| NORTHSIDE | 3/18/2008 | S21309 | 2019 N. EVANSTON | | GREASE | |
| NORTHSIDE | 3/18/2008 | S21309 | 4929 E. 26TH PL. | 89,920 | RAIN | |
| NORTHSIDE | 3/18/2008 | S21309 | 2015 N. EVANSTON | | GREASE | |
| NORTHSIDE | 3/18/2008 | S21309 | 727 E. 56TH ST N. | 40,083 | ROOT | MANHOLE |
| NORTHSIDE | 3/18/2008 | S21309 | 12227 E. 38TH PL | | ROOT | |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 3/18/2008 | S21309 | 1411 N. ROSEDALE | 5,320 | RAIN | |
| NORTHSIDE | 3/18/2008 | S21309 | 4929 E. 26TH PL | | RAIN | |
| NORTHSIDE | 3/19/2008 | S21309 | 1848 N. DENVER AVE. | 2,880 | GREASE | |
| NORTHSIDE | 3/19/2008 | S21309 | 4631 E. 2ND ST | | RAIN | MANHOLE |
| NORTHSIDE | 3/25/2008 | S21309 | 5132 N. UTICA AVE. | 5,790 | ROOT | MANHOLE |
| NORTHSIDE | 3/25/2008 | S21309 | 3132 S. 70TH E. AVE | | CLEANING CREW | |
| NORTHSIDE | 3/26/2008 | S21309 | 436 S. 92ND E. AVE | | ROOT | |
| NORTHSIDE | 4/2/2008 | S21309 | 1328 N CANTON AVE. | | GREASE STOPPAGE | MANHOLE |
| NORTHSIDE | 4/2/2008 | S21309 | 2436 N CINCINNATI AVE. | | RAIN | |
| NORTHSIDE | 4/8/2008 | S21309 | 1324 S. GARY AVE | 1,440 | RAIN | MANHOLE |
| NORTHSIDE | 4/8/2008 | S21309 | 3749 S. 124TH E. AVE | 240 | GREASE | |
| NORTHSIDE | 4/8/2008 | S21309 | 3749 S. 124TH E. AVE | | GREASE | |
| NORTHSIDE | 4/8/2008 | S21309 | 4935 E. 4TH | | RAIN | MANHOLE |
| NORTHSIDE | 4/8/2008 | S21309 | 807 S. NEW HAVEN | | RAIN | |
| NORTHSIDE | 4/8/2008 | S21309 | 721 N. NEW HAVEN | 23,160 | RAIN | |
| NORTHSIDE | 4/8/2008 | S21309 | 1547 N. VANDALIA | 31,395 | RAIN | MANHOLE |
| NORTHSIDE | 4/8/2008 | S21309 | 3622 E. 15TH | | RAIN | |
| NORTHSIDE | 4/8/2008 | S21309 | 1540 N. YALE | 62,725 | RAIN | MANHOLE |
| NORTHSIDE | 4/8/2008 | S21309 | 20550 E. 4TH | 8,245 | RAIN | LIFT STATION |
| NORTHSIDE | 4/8/2008 | S21309 | 1411 N. ROSEDALE | 204,018 | RAIN | |
| NORTHSIDE | 4/8/2008 | S21309 | 1409 N. ROSEDALE AVE | 354,734 | RAIN | MANHOLE |
| NORTHSIDE | 4/8/2008 | S21309 | 700 N. HARVARD | 23,520 | RAIN | MANHOLE |
| NORTHSIDE | 4/8/2008 | S21309 | 2137 N. PITTSBURG | 257,655 | RAIN | MANHOLE |
| NORTHSIDE | 4/9/2008 | S21309 | 1409 N. ROSEDALE AVE. | 81,120 | RAIN | MANHOLE |
| NORTHSIDE | 4/9/2008 | S21309 | 5913 E. MARSHALL ST | | BROKEN MAIN | |
| NORTHSIDE | 4/9/2008 | S21309 | 2226 S. 85TH E AVE. | 26 | BROKEN MAIN | |
| NORTHSIDE | 4/9/2008 | S21309 | 1547 N. VANDALIA AVE. | 16,700 | CLEANING CREW | MANHOLE |
| NORTHSIDE | 4/10/2008 | S21309 | 909 S. MEMORIAL DR. | 98,430 | RAIN | MANHOLE |
| NORTHSIDE | 4/10/2008 | S21309 | 740 N. NEW HAVEN | 63,360 | RAIN | MANHOLE |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 4/10/2008 | S21309 | 1208 S. FLORENCE PL. | | RAIN | |
| NORTHSIDE | 4/10/2008 | S21309 | 2828 E. 1ST | | RAIN | |
| NORTHSIDE | 4/10/2008 | S21309 | 5709 E. 4TH TERRACE | | RAIN | |
| NORTHSIDE | 4/10/2008 | S21309 | 5703 E. 4TH TERRACE | | RAIN | |
| NORTHSIDE | 4/10/2008 | S21309 | 4935 E. 4TH | | RAIN | MANHOLE |
| NORTHSIDE | 4/10/2008 | S21309 | 5751 E. 4TH PL | | RAIN | MANHOLE |
| NORTHSIDE | 4/10/2008 | S21309 | 1355 N. 77TH E. AVE | | RAIN | MANHOLE |
| NORTHSIDE | 4/10/2008 | S21309 | 102 S. 91ST E. AVE | | RAIN | |
| NORTHSIDE | 4/10/2008 | S21309 | 731 N. NEW HAVEN | 53,040 | RAIN | MANHOLE |
| NORTHSIDE | 4/10/2008 | S21309 | 812 N. OSWEGO | 361,725 | RAIN | MANHOLE |
| NORTHSIDE | 4/10/2008 | S21309 | 1447 S. CANTON AVE | 61,440 | RAIN | MANHOLE |
| NORTHSIDE | 4/10/2008 | S21309 | 203 S. 200TH E. AVE | 18 | RAIN | |
| NORTHSIDE | 4/10/2008 | S21309 | 43 S. 200TH E. AVE | 480,480 | RAIN | MANHOLE |
| NORTHSIDE | 4/10/2008 | S21309 | 6749 E. 6TH | > 8,000,000 | RAIN | MANHOLE |
| NORTHSIDE | 4/10/2008 | S21309 | 945 S. MEMORIAL DR. | | RAIN | |
| NORTHSIDE | 4/10/2008 | S21309 | 5820 E. 15TH | > 1,000,000 | RAIN | MANHOLE |
| NORTHSIDE | 4/10/2008 | S21309 | 700 N. HARVARD | 402,560 | RAIN | MANHOLE |
| NORTHSIDE | 4/10/2008 | S21309 | 1540 N. YALE | 718,080 | RAIN | MANHOLE |
| NORTHSIDE | 4/10/2008 | S21309 | 638 E. MARSHALL | | RAIN | |
| NORTHSIDE | 4/10/2008 | S21309 | 721 N. NEW HAVEN | 63,360 | RAIN | MANHOLE |
| NORTHSIDE | 4/10/2008 | S21309 | 4309 N. GARRISON | 1,024 | GREASE | |
| NORTHSIDE | 4/10/2008 | S21309 | 1518 MAPLEWOOD AVE | UNKNOWN | RAIN | |
| NORTHSIDE | 4/10/2008 | S21309 | 1521 MAPLEWOOD AVE. | | RAIN | MANHOLE |
| NORTHSIDE | 4/11/2008 | S21309 | 1411 ROSEDALE AVE. | 43,650 | RAIN | |
| NORTHSIDE | 4/11/2008 | S21309 | 9109 E. LATIMER ST. | UNKNOWN | RAIN | |
| NORTHSIDE | 4/24/2008 | S21309 | 1220 N. CANTON AVE | | RAIN | |
| NORTHSIDE | 4/24/2008 | S21309 | 1208 S. FLORENCE PL. | | RAIN | |
| NORTHSIDE | 4/24/2008 | S21309 | 4935 E. 4TH | | RAIN | MANHOLE |
| NORTHSIDE | 4/24/2008 | S21309 | 812 N. OSWEGO AVE | 161,840 | RAIN | MANHOLE |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 4/24/2008 | S21309 | 740 N. NEW HAVEN AVE | 57,024 | RAIN | MANHOLE |
| NORTHSIDE | 4/24/2008 | S21309 | 721 N. NEW HAVEN AVE | 14,640 | RAIN | MANHOLE |
| NORTHSIDE | 4/24/2008 | S21309 | 151 N. MARION AVE | 15,120 | RAIN | MANHOLE |
| NORTHSIDE | 4/24/2008 | S21309 | 5820 E. 15TH | 328,735 | RAIN | MANHOLE |
| NORTHSIDE | 4/24/2008 | S21309 | 2508 E. 15TH | 134,135 | RAIN | MANHOLE |
| NORTHSIDE | 4/24/2008 | S21309 | 5889 E. 22ND PL. | | RAIN | MANHOLE |
| NORTHSIDE | 4/25/2008 | S21309 | 1411 N. ROSEDALE AVE. | | RAIN | |
| NORTHSIDE | 4/28/2008 | S21309 | 721 N. NEW HAVEN AVE | 399,130 | RAIN | MANHOLE |
| NORTHSIDE | 4/30/2008 | S21309 | 10627 E 18 PL | 5,040 | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 5/5/2008 | S21309 | 1202 S OSWEGO AVE. | | RAIN | MANHOLE |
| NORTHSIDE | 5/7/2008 | S21309 | 5727 E. 4 PL. | 31,510 | RAIN | |
| NORTHSIDE | 5/7/2008 | S21309 | 1411 N. ROSEDALE AVE. | 50,639 | RAIN | |
| NORTHSIDE | 5/7/2008 | S21309 | 5709 E 4 TERRACE | | RAIN | |
| NORTHSIDE | 5/7/2008 | S21309 | 5751 E 4 PL. | 187,005 | RAIN | MANHOLE |
| NORTHSIDE | 5/7/2008 | S21309 | 5703 E. 4 TERRACE | | RAIN | |
| NORTHSIDE | 5/8/2008 | S21309 | 4935 E. 4 ST. | | RAIN | MANHOLE |
| NORTHSIDE | 5/8/2008 | S21309 | 812 N. OSWEGO AVE. | 68,680 | RAIN | MANHOLE |
| NORTHSIDE | 5/8/2008 | S21309 | 6910 E. NEWTON PL. | 720 | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 5/8/2008 | S21309 | 740 N. NEW HAVEN AVE. | 97,465 | RAIN | MANHOLE |
| NORTHSIDE | 5/8/2008 | S21309 | 6914 E. NEWTON PL. | | BROKEN MAIN | |
| NORTHSIDE | 5/8/2008 | S21309 | 721 N. NEW HAVEN AVE. | 168,670 | RAIN | MANHOLE |
| NORTHSIDE | 5/8/2008 | S21309 | 1355 N. 77 E. AVE. | | RAIN | MANHOLE |
| NORTHSIDE | 5/8/2008 | S21309 | 6904 E. NEWTON ST. | 5,600 | BROKEN MAIN | |
| NORTHSIDE | 5/8/2008 | S21309 | 7888 E. KING ST. | | DEBRIS STOPPAGE | |
| NORTHSIDE | 5/14/2008 | S21309 | 2720 S. 129 E. AVE. | 80 | GREASE STOPPAGE | |
| NORTHSIDE | 5/14/2008 | S21309 | 1355 N. 77 E. AVE. | | UNKNOWN | MANHOLE |
| NORTHSIDE | 5/22/2008 | S21309 | 6005 S. OSWEGO AVE. | 6 | ROOT STOPPAGE | |
| NORTHSIDE | 5/25/2008 | S21309 | 11708 E. 17 PL. | | ROOT STOPPAGE | |
| NORTHSIDE | 5/27/2008 | S21309 | 5811 E. TECUMSEH ST. | 70,140 | RAIN | MANHOLE |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 5/27/2008 | S21309 | 721 N. NEW HAVEN AVE. | 85,995 | RAIN | MANHOLE |
| NORTHSIDE | 5/27/2008 | S21309 | 740 N. NEW HAVEN AVE. | 85,995 | RAIN | MANHOLE |
| NORTHSIDE | 5/27/2008 | S21309 | 700 N. HARVARD AVE. | 56,446 | RAIN | MANHOLE |
| NORTHSIDE | 5/27/2008 | S21309 | 6749 E 6 ST. | 5,040 | RAIN | MANHOLE |
| NORTHSIDE | 5/27/2008 | S21309 | 4935 E 4 ST. | | RAIN | MANHOLE |
| NORTHSIDE | 5/27/2008 | S21309 | 4935 E 4 ST | | RAIN | MANHOLE |
| NORTHSIDE | 5/27/2008 | S21309 | 1411 N. ROSEDALE AVE. | 6,660 | RAIN | |
| NORTHSIDE | 5/27/2008 | S21309 | 835 N. JOPLIN AVE. | 65,520 | RAIN | MANHOLE |
| NORTHSIDE | 5/27/2008 | S21309 | 1509 N. 66 E. AVE. | | RAIN | |
| NORTHSIDE | 5/27/2008 | S21309 | 2137 N. PITTSBURG | | RAIN | |
| NORTHSIDE | 5/27/2008 | S21309 | 2137 N. PITTSBURG AVE. | 85,995 | RAIN | MANHOLE |
| NORTHSIDE | 5/27/2008 | S21309 | 5709 E 4 TERRACE | | RAIN | |
| NORTHSIDE | 5/27/2008 | S21309 | 1409 N. ROSEDALE AVE. | 8,160 | RAIN | MANHOLE |
| NORTHSIDE | 5/27/2008 | S21309 | 1521 N. MAPLEWOOD AVE. | 10,416 | RAIN | MANHOLE |
| NORTHSIDE | 5/27/2008 | S21309 | 7460 E. 3 ST. | | RAIN | |
| NORTHSIDE | 5/27/2008 | S21309 | 5751 E 4 PLACE | 125,250 | RAIN | MANHOLE |
| NORTHSIDE | 5/27/2008 | S21309 | 1355 N. 77 E. AVE. | | RAIN | MANHOLE |
| NORTHSIDE | 5/27/2008 | S21309 | 1540 N. YALE AVE. | 161,070 | RAIN | MANHOLE |
| NORTHSIDE | 5/27/2008 | S21309 | 1518 N MAPLEWOOD AVE. | 1,752 | RAIN | |
| NORTHSIDE | 5/27/2008 | S21309 | 5810 E. TECUMSEH ST. | 155,310 | RAIN | MANHOLE |
| NORTHSIDE | 5/27/2008 | S21309 | 5703 E 4 TERRACE | | RAIN | |
| NORTHSIDE | 5/28/2008 | S21309 | 1247 S. MARION AVE. | | RAIN | |
| NORTHSIDE | 5/28/2008 | S21309 | 5713 E. TECUMSEH ST. | 46,320 | RAIN | MANHOLE |
| NORTHSIDE | 5/29/2008 | S21309 | 5407 N. JOHNSTOWN AVE. | | GREASE STOPPAGE | MANHOLE |
| NORTHSIDE | 5/30/2008 | S21309 | 1202 S. OSWEGO AVE. | | RAIN | MANHOLE |
| NORTHSIDE | 5/31/2008 | S21309 | 1411 N. ROSEDALE | | RAIN | |
| NORTHSIDE | 5/31/2008 | S21309 | 1409 E. WOODROW PL. | 640 | DEBRIS STOPPAGE | |
| NORTHSIDE | 6/1/2008 | S21309 | 4631 E. 2 ST. | 63,690 | RAIN | MANHOLE |
| NORTHSIDE | 6/1/2008 | S21309 | 4901 E. 4 ST. | | RAIN | MANHOLE |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 6/1/2008 | S21309 | 1411 N. ROSEDALE AVE. | | RAIN | |
| NORTHSIDE | 6/1/2008 | S21309 | 1123 S. GARY PLACE. | | RAIN | |
| NORTHSIDE | 6/1/2008 | S21309 | 812 N. OSWEGO AVE. | 81,900 | RAIN | MANHOLE |
| NORTHSIDE | 6/1/2008 | S21309 | 740 N. NEW HAVEN AVE. | 40,800 | RAIN | MANHOLE |
| NORTHSIDE | 6/1/2008 | S21309 | 4901 E. 4 ST. | | RAIN | MANHOLE |
| NORTHSIDE | 6/2/2008 | S21309 | 3622 E. 15TH | | RAIN | |
| NORTHSIDE | 6/2/2008 | S21309 | 5731 N. GARRISON PL. | | RAIN | MANHOLE |
| NORTHSIDE | 6/2/2008 | S21309 | 4003 E. 11TH | | RAIN | MANHOLE |
| NORTHSIDE | 6/2/2008 | S21309 | 721 N. NEW HAVEN AVE. | 115,800 | RAIN | MANHOLE |
| NORTHSIDE | 6/3/2008 | S21309 | 2641 E. MARSHALL | | ROOT | MANHOLE |
| NORTHSIDE | 6/4/2008 | S21309 | 17929 E. ADMIRAL BL. | 1,440 | EQUIPMENT FAILURE | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 43 S. 200 E. AVE. | 68,880 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 2805 E ADMIRAL PLACE | 6,816 | RAIN | |
| NORTHSIDE | 6/9/2008 | S21309 | 638 E. MARSHALL ST. | | RAIN | |
| NORTHSIDE | 6/9/2008 | S21309 | 1417 N. LANSING AVE. | | RAIN | |
| NORTHSIDE | 6/9/2008 | S21309 | 902 E. PINE ST. | | RAIN | |
| NORTHSIDE | 6/9/2008 | S21309 | 2806 N. GARRISON AVE. | 2,544 | DEBRIS STOPPAGE | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 1447 S. DARLINGTON AVE. | 399,510 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 5810 E. TECUMSEH ST. | 398,034 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 812 N OSWEGO AVE. | 727,610 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 1447 S. ERIE AVE. | 399,510 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 2845 E. ADMIRAL PLACE | 41,109 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 203 S. 200 E. AVE. | | RAIN | |
| NORTHSIDE | 6/9/2008 | S21309 | 20550 E. 4 ST | 10,695 | RAIN | |
| NORTHSIDE | 6/9/2008 | S21309 | 5519 E 15 ST. | 136,940 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 1521 N MAPLEWOOD AVE. | 529,390 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 1355 N. 77 E. AVE. | 358,995 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 1447 S CANTON AVE. | 198,730 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 4901 E 4 ST. | 317,300 | RAIN | MANHOLE |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 6/9/2008 | S21309 | 1548 S LOUISVILLE AVE. | 139,230 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 6749 E. 6 ST. | 369,360 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 5751 E 4 PLACE | 459,250 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 464 S. JOPLIN AVE. | 9,360 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 4920 E 7 ST. | 1,010 | RAIN | |
| NORTHSIDE | 6/9/2008 | S21309 | 727 E. 56 ST. N. | 136,272 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 5800 E. EASTON ST. | 209,405 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 3300 S 116 E AVE. | 523,665 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 5709 E. 4 TERRACE | 45,920 | RAIN | |
| NORTHSIDE | 6/9/2008 | S21309 | 5910 E 4 PL. | 9,360 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 9720 E 15 ST. | | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 700 N. HARVARD AVE. | 487,640 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 1903 N. ATLANTA PLACE | 469,270 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 514 N. JOPLIN AVE. | 296,205 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 740 N NEW HAVEN AVE. | 98,196 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 5368 E 21. ST | 90,324 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 151 N. MARION AVE. | 567,800 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 3503 E 5 PL. | 357,730 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 835 N. JOPLIN AVE. | 414,950 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 5731 N. GARRISON PL. | 138,610 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 3503 E. 5 PLACE | 357,730 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 5811 E. TECUMSEH ST. | 398,034 | RAIN | MANHOLE |
| NORTHSIDE | 6/9/2008 | S21309 | 128 S. WAVERLY DR. | | RAIN | |
| NORTHSIDE | 6/10/2008 | S21309 | 801 N. MINGO RD. | 509,520 | RAIN | MANHOLE |
| NORTHSIDE | 6/10/2008 | S21309 | 1737 E. YOUNG PLACE | 11,580 | GREASE STOPPAGE | MANHOLE |
| NORTHSIDE | 6/10/2008 | S21309 | 5820 E. 15 ST. | 464,260 | RAIN | MANHOLE |
| NORTHSIDE | 6/16/2008 | S21309 | 5910 E. 4 PLACE | 281,190 | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 6/16/2008 | S21309 | 5751 E. 4 PLACE | 345,690 | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 6/16/2008 | S21309 | 463 S. JOPLIN AVE. | 21,390 | BROKEN MAIN | |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 6/16/2008 | S21309 | 457 S. JOPLIN AVE. | 345 | BROKEN MAIN | |
| NORTHSIDE | 6/17/2008 | S21309 | 2436 N CINCINNATI AVE. | | RAIN | |
| NORTHSIDE | 6/17/2008 | S21309 | 1411 N. ROSEDALE AVE. | | RAIN | |
| NORTHSIDE | 6/18/2008 | S21309 | 1411 N. ROSEDALE AVE. | | RAIN | |
| NORTHSIDE | 6/19/2008 | S21309 | 2432 N. CINCINNATI AVE. | | RAIN | |
| NORTHSIDE | 6/20/2008 | S21309 | 3878 S. 98TH E. AVE | | ROOT | |
| NORTHSIDE | 7/2/2008 | S21309 | 6732 E. 27 PLACE | 80 | GREASE STOPPAGE | |
| NORTHSIDE | 7/5/2008 | S21309 | 7460 E. 3RD | 2,304 | DEBRIS | |
| NORTHSIDE | 7/8/2008 | S21309 | 2930 S. 94TH E. AVE | 720 | ROOT | |
| NORTHSIDE | 7/9/2008 | S21309 | 5930 E. 4TH PL. | 46,320 | DEBRIS | MANHOLE |
| NORTHSIDE | 7/9/2008 | S21309 | 5910 E. 4TH PL. | 56,760 | DEBRIS | MANHOLE |
| NORTHSIDE | 7/10/2008 | S21309 | 1411 N. ROSEDALE AVE. | | RAIN | |
| NORTHSIDE | 7/14/2008 | S21309 | 1507 N. MAIN ST. | 680 | DEBRIS STOPPAGE | |
| NORTHSIDE | 7/22/2008 | S21309 | 2226 S. 85TH E. AVE | 104 | BROKEN MAIN | |
| NORTHSIDE | 8/12/2008 | S21309 | 5403 N. ELGIN AVE. | | GREASE STOPPAGE | |
| NORTHSIDE | 9/12/2008 | S21309 | 4803 N. XANTHUS AVE. | | GREASE STOPPAGE | |
| NORTHSIDE | 9/15/2008 | S21309 | 6108 N. PEORIA AVE. | | CLEANING CREW | |
| NORTHSIDE | 9/15/2008 | S21309 | 2535 S. DARLINGTON AVE. | 6,120 | ROOT | MANHOLE |
| NORTHSIDE | 9/24/2008 | S21309 | 4910 N. GARRISON PL. | | GREASE | |
| NORTHSIDE | 9/25/2008 | S21309 | 6739 N. TRENTON AVE. | | CLEANING CREW | |
| NORTHSIDE | 10/4/2008 | S21309 | 4649 N. DETROIT AVE. | | ROOT | |
| NORTHSIDE | 10/8/2008 | S21309 | 1351 E. 53RD ST N. | 400 | ROOT | |
| NORTHSIDE | 10/20/2008 | S21309 | | | | |
| NORTHSIDE | 10/20/2008 | S21309 | 16600 E. PINE ST. | | DEBRIS | MANHOLE |
| NORTHSIDE | 10/20/2008 | S21309 | 1720 N. 161ST E. AVE | 62 | DEBRIS | MANHOLE |
| NORTHSIDE | 10/21/2008 | S21309 | 12509 E. 26TH | | ROOT | |
| NORTHSIDE | 10/27/2008 | S21309 | 6358 E. NEWTON ST. | | GREASE | |
| NORTHSIDE | 11/8/2008 | S21309 | 8707 E. 71ST | 1,776 | GREASE | MANHOLE |
| NORTHSIDE | 11/10/2008 | S21309 | 2534 E. KING ST. | | CLEANING CREW | |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 11/26/2008 | S21309 | 6536 E. 25 PL | 1,488 | DEBRIS STOPPAGE | MANHOLE |
| NORTHSIDE | 12/3/2008 | S21309 | 615 E. 42 ST N. | 160 | ROOT STOPPAGE | |
| NORTHSIDE | 12/4/2008 | S21309 | 10149 E. 32ND | | GREASE | |
| NORTHSIDE | 12/6/2008 | S21309 | 2401 N. COLUMBIA AVE | | GREASE | |
| NORTHSIDE | 12/13/2008 | S21309 | 4717 S. 94TH E. AVE | | GREASE | |
| NORTHSIDE | 12/15/2008 | S21309 | 1422 S. 99TH E. AVE | 2,040 | GREASE | MANHOLE |
| NORTHSIDE | 12/18/2008 | S21309 | 2013 N. DELAWARE PL. | | GREASE | |
| NORTHSIDE | 12/18/2008 | S21309 | 1508 N. FLORENCE AVE | | GREASE | |
| NORTHSIDE | 12/19/2008 | S21309 | 577 E. 59TH ST. N | | DEBRIS | |
| NORTHSIDE | 12/20/2008 | S21309 | 4201 E. 11TH | | GREASE | |
| NORTHSIDE | 12/29/2008 | S21309 | | 1,500 | RAIN | |
| NORTHSIDE | 1/5/2009 | S21309 | 1936 S. 131ST E. AVE | | GREASE | MANHOLE |
| NORTHSIDE | 1/9/2009 | S21309 | 12237 E. 39TH | 21,230 | DEBRIS | MANHOLE |
| NORTHSIDE | 1/11/2009 | S21309 | 5910 E. 4TH PL. | | DEBRIS | MANHOLE |
| NORTHSIDE | 1/12/2009 | S21309 | 1580 S. 79TH E. AVE | 21,060 | BROKEN MAIN | PIPE |
| NORTHSIDE | 1/12/2009 | S21309 | 1223 N. GRANITE AVE | 1,680 | GREASE | MANHOLE |
| NORTHSIDE | 1/14/2009 | S21309 | 10339 E. 21ST PL. | | ROOT | |
| NORTHSIDE | 1/20/2009 | S21309 | 5555 E. OKLAHOMA PL. | | CLEANING CREW | |
| NORTHSIDE | 1/20/2009 | S21309 | 5555 E. OKLAHOMA PL. | | VANDALISM | |
| NORTHSIDE | 1/24/2009 | S21309 | 2113 N. NORFOLK AVE | | GREASE | |
| NORTHSIDE | 1/28/2009 | S21309 | 2701 S. 131ST E. AVE | | ROOT | |
| NORTHSIDE | 1/28/2009 | S21309 | 2707 S. 131ST E. AVE | | ROOT | |
| NORTHSIDE | 1/30/2009 | S21309 | 2204 N. MADISON AVE | 1,440 | GREASE | MANHOLE |
| NORTHSIDE | 2/5/2009 | S21309 | 2861 E 42 ST N. | | GREASE STOPPAGE | MANHOLE |
| NORTHSIDE | 2/7/2009 | S21309 | 5404 S. MEMORIAL DR. | 480 | GREASE | MANHOLE |
| NORTHSIDE | 2/9/2009 | S21309 | 11702 E. 25TH | | GREASE | |
| NORTHSIDE | 2/11/2009 | S21309 | 2312 N ATLANTA PL | | GREASE STOPPAGE | |
| NORTHSIDE | 2/11/2009 | S21309 | 9719 E 4 ST | 480 | GREASE STOPPAGE | MANHOLE |
| NORTHSIDE | 2/13/2009 | S21309 | 7990 E 51 ST | | GREASE STOPPAGE | |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 2/20/2009 | S21309 | 1807 N PEORIA AVE. | 1,760 | ROOT STOPPAGE | |
| NORTHSIDE | 2/20/2009 | S21309 | 1801 N. PEORIA AVE. | 10,615 | ROOT STOPPAGE | MANHOLE |
| NORTHSIDE | 2/21/2009 | S21309 | 1627 S 126 E AVE. | | GREASE STOPPAGE | |
| NORTHSIDE | 2/25/2009 | S21309 | 2147 N. OWASSO AVE. | | GREASE STOPPAGE | MANHOLE |
| NORTHSIDE | 3/3/2009 | S21309 | 1925 N SHERIDAN RD | 6,346 | VANDALISM | |
| NORTHSIDE | 3/3/2009 | S21309 | 12810 E 23 ST | | ROOT STOPPAGE | |
| NORTHSIDE | 3/4/2009 | S21309 | 12810 E 23 ST | | ROOT STOPPAGE | |
| NORTHSIDE | 3/22/2009 | S21309 | 5103 S. 76TH E. AVE | 1,584 | ROOT | MANHOLE |
| NORTHSIDE | 3/25/2009 | S21309 | 1828 N DENVER AVE. | | DEBRIS STOPPAGE | |
| NORTHSIDE | 3/29/2009 | S21309 | 5910 E. 4TH PL | 275,550 | RAIN | MANHOLE |
| NORTHSIDE | 3/29/2009 | S21309 | 5751 E. 4TH PL | 275,550 | RAIN | MANHOLE |
| NORTHSIDE | 3/30/2009 | S21309 | APACHE L.S. - 10302 E. APACHE AVE | 10,000 | RAIN/SNOW | LAGOON/BASIN |
| NORTHSIDE | 4/4/2009 | S21309 | 729 N. FLORENCE PL. | | DEBRIS | |
| NORTHSIDE | 4/12/2009 | S21309 | 5910 E. 4TH PL. | 407,480 | RAIN | MANHOLE |
| NORTHSIDE | 4/12/2009 | S21309 | 5751 E. 4TH PL | 236,425 | RAIN | MANHOLE |
| NORTHSIDE | 4/14/2009 | S21309 | 1416 N. FULTON AVE | 1,904 | GREASE | MANHOLE |
| NORTHSIDE | 4/14/2009 | S21309 | 5429 E. MARSHALL ST. | 1,904 | GREASE | MANHOLE |
| NORTHSIDE | 4/17/2009 | S21309 | 2429 S. 132ND E. AVE | 1,680 | ROOT | MANHOLE |
| NORTHSIDE | 4/17/2009 | S21309 | 1833 S. 124TH E. AVE | | GREASE | |
| NORTHSIDE | 4/18/2009 | S21309 | 2820 S. 116TH E. AVE | | GREASE | |
| NORTHSIDE | 4/18/2009 | S21309 | 11511 E. 28TH PL. - APT. "G" & "H" | | GREASE | |
| NORTHSIDE | 4/21/2009 | S21309 | 2213 N. DELAWARE PL. | | GREASE | |
| NORTHSIDE | 4/30/2009 | S21309 | 6323 S. 109TH E. AVE | | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 4/30/2009 | S21309 | 5910 E. 4TH PL. | | DEBRIS | MANHOLE |
| NORTHSIDE | 5/1/2009 | S21309 | 5962 E. 33RD | | RAIN | MANHOLE |
| NORTHSIDE | 5/1/2009 | S21309 | 5910 E. 4TH PL | 172,856 | RAIN | MANHOLE |
| NORTHSIDE | 5/1/2009 | S21309 | 203 S. 200TH E. AVE | 10 | RAIN | |
| NORTHSIDE | 5/1/2009 | S21309 | 4717 S. YALE | 10,200 | RAIN | MANHOLE |
| NORTHSIDE | 5/1/2009 | S21309 | 721 N. NEW HAVEN AVE | 344,354 | RAIN | MANHOLE |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 5/1/2009 | S21309 | 1355 N. 77TH E. AVE | 226,389 | RAIN | MANHOLE |
| NORTHSIDE | 5/1/2009 | S21309 | 4624 E. 11TH | | ROOT | |
| NORTHSIDE | 5/1/2009 | S21309 | 4618 E. 11TH | | ROOT | |
| NORTHSIDE | 5/1/2009 | S21309 | 123 S. 200TH E. AVE | 304,440 | RAIN | MANHOLE |
| NORTHSIDE | 5/1/2009 | S21309 | 5751 E. 4TH PL | 244,724 | RAIN | MANHOLE |
| NORTHSIDE | 5/1/2009 | S21309 | 4624 E. 11 | 3,424 | ROOT | PIPE |
| NORTHSIDE | 5/1/2009 | S21309 | 6749 E. 6TH | > 2,000,000 | RAIN | MANHOLE |
| NORTHSIDE | 5/1/2009 | S21309 | 203 S. QUEBEC AVE | 144,840 | RAIN | MANHOLE |
| NORTHSIDE | 5/1/2009 | S21309 | 3744 E. 3RD | 407,230 | RAIN | MANHOLE |
| NORTHSIDE | 5/1/2009 | S21309 | 721 N. NEW HAVEN | > 3,000,000 | RAIN | MANHOLE |
| NORTHSIDE | 5/1/2009 | S21309 | 10851 E. 33RD | | RAIN | |
| NORTHSIDE | 5/1/2009 | S21309 | 5820 E. 15TH | > 2,000,000 | RAIN | MANHOLE |
| NORTHSIDE | 5/1/2009 | S21309 | 4021 N. GARRISON | 62,160 | RAIN | MANHOLE |
| NORTHSIDE | 5/1/2009 | S21309 | 22 S. 68TH E. AVE | 120 | BROKEN MAIN | |
| NORTHSIDE | 5/1/2009 | S21309 | 4622 E. 11 | 1,117 | ROOT | |
| NORTHSIDE | 5/8/2009 | S21309 | 1521 N. MAPLEWOOD AVE | | RAIN | MANHOLE |
| NORTHSIDE | 5/14/2009 | S21309 | 5946 E. 4TH | | RAIN | MANHOLE |
| NORTHSIDE | 5/14/2009 | S21309 | 5751 E. 4TH PL. | | RAIN | MANHOLE |
| NORTHSIDE | 5/15/2009 | S21309 | 4009 E. XYLER ST. | | DEBRIS | MANHOLE |
| NORTHSIDE | 5/19/2009 | S21309 | 5216 E. OKLAHOMA | | SCHEDULE CLEANING | |
| NORTHSIDE | 6/8/2009 | S21309 | 6946 E. OKLAHOMA ST. | 480 | GREASE | MANHOLE |
| NORTHSIDE | 6/9/2009 | S21309 | 744 E. 33RD ST. | 48 | ROOTS | |
| NORTHSIDE | 6/9/2009 | S21309 | 748 E. 33RD ST | 48 | ROOTS | |
| NORTHSIDE | 6/9/2009 | S21309 | 738 E. 33RD ST. | | ROOT | |
| NORTHSIDE | 6/9/2009 | S21309 | 4619 S. 72ND E. PL | 1,440 | VANDALISM | MANHOLE |
| NORTHSIDE | 6/13/2009 | S21309 | 16615 E. 4TH ST | 4,320 | POWER FAILURE | MANHOLE |
| NORTHSIDE | 6/13/2009 | S21309 | 16612 E. 4TH ST | 4,320 | EQUIPMENT FAILURE | MANHOLE |
| NORTHSIDE | 6/26/2009 | S21309 | 4719 S. 69TH E. AVE | 160 | ROOT | |
| NORTHSIDE | 7/9/2009 | S21309 | 1522 N. COLUMBIA AVE | | GREASE | MANHOLE |

| Facility Name | Date | Facility ID | Location | Amount (Gal) | Cause | Type of Source |
|---|---|---|---|---|---|---|
| NORTHSIDE | 7/23/2009 | S21309 | 2405 S 132 E AVE. | | UNKNOWN | |
| NORTHSIDE | 7/26/2009 | S21309 | 1711 S. 106 E. AVE | 12,960 | BROKEN MAIN | MANHOLE |
| NORTHSIDE | 7/26/2009 | S21309 | 1711 S.106 E. AVE. | | BROKEN MAIN | |
| NORTHSIDE | 8/5/2009 | S21309 | 10113 E. 12TH ST | 3,600 | DEBRIS | MANHOLE |
| NORTHSIDE | 8/5/2009 | S21309 | 1217 S. 101ST E. AVE | 600 | DEBRIS | |
| NORTHSIDE | 8/28/2009 | S21309 | 2174 S. 106TH E. AVE. | | DEBRIS | MANHOLE |
| NORTHSIDE | 9/18/2009 | S21309 | 2724 S. 117TH E. AVE | 120 | ROOT | |
| NORTHSIDE | 9/19/2009 | S21309 | 1649 S. 110TH E. PL | 480 | GREASE | MANHOLE |
| NORTHSIDE | 9/21/2009 | S21309 | 4209 N. EVANSTON PL. | 320 | POWER FAILURE | LIFT STATION |
| NORTHSIDE | 9/21/2009 | S21309 | 1544 S. 74TH E. AVE | | RAIN | MANHOLE |
| NORTHSIDE | 9/21/2009 | S21309 | 1198 S. 79TH E. AVE | 30,060 | VANDALISM | MANHOLE |
| NORTHSIDE | 9/21/2009 | S21309 | 1544 S. 74TH E. AVE | | RAIN | |
| NORTHSIDE | 9/21/2009 | S21309 | 1536 S. GARY PL | | RAIN | |
| NORTHSIDE | 9/21/2009 | S21309 | 9825 E. 21ST | | RAIN | MANHOLE |
| NORTHSIDE | 9/21/2009 | S21309 | 1823 S. JOPLIN AVE | | ROOT | |
| NORTHSIDE | 9/21/2009 | S21309 | 3300 S. 116TH E. AVE | 525,450 | RAIN | MANHOLE |
| NORTHSIDE | 9/21/2009 | S21309 | 3311 S. 114TH E. AVE | 249,795 | RAIN | MANHOLE |
| NORTHSIDE | 9/21/2009 | S21309 | 1102 S. YALE AVE | | RAIN | |
| NORTHSIDE | 9/22/2009 | S21309 | 2010 S. 68TH E. AVE | | RAIN | |
| NORTHSIDE | 9/22/2009 | S21309 | 9720 E. 15TH | | RAIN | MANHOLE |
| NORTHSIDE | 9/22/2009 | S21309 | 9715 E. 13TH PL | | RAIN | MANHOLE |
| NORTHSIDE | 9/22/2009 | S21309 | 102 S. 91ST E. AVE | | RAIN | |
| NORTHSIDE | 9/23/2009 | S21309 | 5710 S. IRVINGTON AVE. | | RAIN | MANHOLE |
| NORTHSIDE | 9/24/2009 | S21309 | 1355 N. 77TH E. AVE | | RAIN | MANHOLE |
| NORTHSIDE | 9/28/2009 | S21309 | 5757 S. MEMORIAL DR. | 73,840 | BROKEN MAIN | PIPE |
| NORTHSIDE | 9/28/2009 | S21309 | 5757 S. MEMORIAL DR. | 73,840 | BROKEN MAIN | PIPE |

# APPENDIX C
# ESTIMATED FLOW EXCEEDANCE PERCENTILES

**Estimated Flow Exceedance Percentiles**

| WQ Station | OK121300010010_001AT | OK121300-01-0090_00M | OK121300-01-0060_00G |
|---|---|---|---|
| | **Lower Bird Creek** | **Coal Creek** | **Ranch Creek** |
| **WBID Segment** | OK121300010010_00 | OK121300010090_00 | OK121300010060_00 |
| **USGS Gage Reference** | 07178200 | 07177800 | 07177800 |
| **Watershed Area (sq. mile)** | 1,103 | 7.53 | 19.3 |
| **Average Annual Rainfall (inch)** | 41.9 | 41.9 | 41.9 |
| **Percentile** | **Q (cfs)** | **Q (cfs)** | **Q (cfs)** |
| 0% | 25,900.0 | 675.0 | 1,733.0 |
| 0.135% | 18,586.2 | 481.6 | 1,236.5 |
| 0.27% | 17,397.0 | 361.5 | 928.1 |
| 1% | 11,800.0 | 157.1 | 403.3 |
| 5% | 4,763.0 | 46.0 | 118.1 |
| 10% | 3,302.0 | 20.0 | 51.3 |
| 15% | 2,360.0 | 9.9 | 25.4 |
| 20% | 1,552.0 | 6.2 | 15.9 |
| 25% | 1,045.0 | 4.8 | 12.3 |
| 30% | 704.0 | 3.8 | 9.8 |
| 35% | 511.1 | 3.0 | 7.7 |
| 40% | 412.4 | 2.5 | 6.4 |
| 45% | 345.7 | 2.2 | 5.6 |
| 50% | 307.0 | 1.8 | 4.6 |
| 55% | 281.3 | 1.6 | 4.1 |
| 60% | 262.0 | 1.4 | 3.6 |
| 65% | 247.0 | 1.1 | 2.8 |
| 70% | 235.2 | 0.9 | 2.4 |
| 75% | 226.0 | 0.8 | 1.9 |
| 80% | 216.0 | 0.6 | 1.5 |
| 85% | 209.0 | 0.4 | 1.1 |
| 90% | 202.0 | 0.3 | 0.7 |
| 95% | 193.0 | 0.2 | 0.4 |
| 99% | 178.1 | 0.0 | 0.0 |
| 99.865% | 162.0 | 0.0 | 0.0 |
| 100% | 69.00 | 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 <u>and</u> 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 this bacteria TMDL report.

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

| ENTITIES | NPDES PERMIT NUMBER | PHASE 1 / PHASE 2 MS4 | PERCENT OF WATERSHED AS MS4 |
|---|---|---|---|
| City of Tulsa[1] | OKS000201 | Phase 1 MS4 | 51.8% |
| City of Catoosa | OKR040033 | Phase 2 MS4 | 2.5% |
| City of Owasso | OKR040029 | Phase 2 MS4 | 7.8% |
| City of Broken Arrow | OKR040001 | Phase 2 MS4 | 0.7% |
| Tulsa County (Urbanized Area) | OKR040019 | Phase 2 MS4 | 3.4% |

[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 Oklahoma Conservation Commission manages Oklahoma’s nonpoint sources pollution and facilitates these actions.

The provisions of this appendix apply only to OPDES/NPDES regulated stormwater discharges. Regulated CAFOs operate under NPDES permits issued and overseen by EPA. However, there are no CAFOs in the Lower Bird Creek watershed.

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. With seven permitted entities in the watershed, it is likely that a cooperative monitoring program would be more cost effective than eleven individual programs. The Indian Nations Council of Governments (INCOG) has expressed interest in facilitating a coordinated monitoring program to address this requirement. Individual permittees are not required to participate in a coordinated program and are free to develop their own program if desired.

After EPA approval of the final TMDL, existing MS4 permittees will be notified of the TMDL provisions and schedule. 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 and 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 may 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 and 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 segments that are 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 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]<br>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]<br>78%[4] | Including creation and restora-tion |

**Sources**

1 BMP Efficiencies Chesapeake Bay Watershed Model (Phase IV) August 1999; Draft FC and Nitrate TMDL IP for Dry River (2001); EPA (1998); EPA(1999b); Novotny (1994); Storm Water Best Management 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

## C. BACTERIAL SOURCE TRACKING RECOMMENDATIONS:

In 2009, INCOG completed a study that compared three methods to help identify bacteria sources as human or non-human in origin: 1) optical brighteners on absorbent filter cloth, 2) optical brighteners measured with a field fluorometer, and 3) lab analysis of chemical markers. The full INCOG report, "*Bacterial Source Tracking on Bird Creek Tributaries*", can be obtained by contacting INCOG. Also, INCOG will assist its members and affiliates in its Green Country Stormwater Alliance with use and data analysis of these methods upon request.

The study revealed that the use of absorbent filter cloths, while easy to deploy and read, were not sensitive to low levels of optical brighteners (OBs). Further, the cloths (fastened to small PVC pipes and anchored in streams for 24 hours), tended to be lost due to high flows or vandalism, and the cloths frequently were covered with silt which obscured the ultraviolet (UV) light fluorescence that would show presence of OBs. Also, this type of OB investigation had to be done over a 24-48 hour period with two site visits (one to deploy and the other to retrieve).

The INCOG study also revealed that the lab analysis of chemical markers was not cost-effective and not reliable for several reasons. First, the lab cost to analyze the parameters was around $400 per sample (parameters were caffeine, 1-4 Dichlorobenzene, cholesterol, coprostanol, b-Estradiol, phenol, Triclosan, Para-Nonylphenol and Tri (2-chloroethyl) Phosphate). Second, it was difficult to find a lab to perform these tests on water samples. Third, some markers are associated with animals, not just humans (e.g., coprostanol and cholesterol), so differentiation was not possible on just these parameters. Third, even moderate stream dilution lowered concentrations below detection limits. The best results from chemical markers are likely to occur under low flow (little to no rainfall runoff) and close to a source of sewage or septage overflow.

The most suitable source tracking method proved to be use of a handheld field fluorometer to directly measure OBs in water while bacteria samples were collected. Even this method had limitations. First, there are presently no calibration standards to easily adjust the instrument to read in parts per million or mg/L. A relative concentration calibration was instead used to compare field measurements to a detergent solution. Second, the unit was not sensitive to very low concentrations, thus moderate stream dilution would mask readings. Despite these limitations, this method showed the greatest promise in being able to differentiate bacteria sources as human or non-human.

There is an increasing need to control bacteria sources in urban areas where there are likely a combination of animal and human sources comingled in urban streams. Being able to trace such sources correctly will lead to more effective reduction of illicit discharges. Use of the handheld fluorometer to trace OBs, and correlate the OB results with bacteria samples, will greatly aid in the identification of human sources that can be controlled.

The following are excerpts taken from the INCOG report.

*The handheld fluorometer was found to be effective in the detection of optical brighteners in surface water, with limitations (see section on calibration information and method development). Optical brighteners in an effluent will vary greatly depending upon where the effluent came from and the activities the effluent or source water was exposed to. This method has utility in discerning between water that has been exposed to detergents, cleaners and products containing optical brighteners and water that has not had this exposure.*

*This instrument could be used to help determine if a water sample is or has been mixed with a wastewater and might be likely to contain high bacterial counts. Useful applications might include the detection of surface water that has been exposed to sanitary sewage, certain types of industrial sewage or flows from onsite disposal operations such as septic or aerobic systems.*

*The three times optical brighteners were detected in the tributaries by the handheld fluorometer (two strong positives and one weak positive) corresponded with the three highest Enterococcus and fecal coliform concentrations… The high optical brightener readings in combination with the high bacterial counts indicated a non-disinfected human waste was likely present.*

*High bacterial counts and high OBs together can indicate failing onsite waste disposal systems, leaking or overflowing sanitary sewers or improperly disinfected wastewater discharge. High bacterial counts and low OBs together can indicate a human derived waste from a source not using OBs or it could be from nonhuman warm blooded animals. A combination of low bacterial counts and high OBs could indicate the presence of gray water (water used for activities such as laundry, dishwashing, bathing, etc., but not water from a toilet) or a disinfected wastewater. Finally, low bacterial counts and low OBs may indicate no evidence of contamination.*

*The optical brightener free cloth in the pipelet holders placed in the three locations that registered the high bacterial counts referred to in the paragraph above did not test positive for optical brighteners.*

*The equipment costs and training for the optical cloth method were minimal. Due to inherent errors, the difficulties in reading the cloth patches and the time consuming nature of this methodology, employing cotton cloth for 24 hours to detect the presence of optical brighteners in surface water was not found to be reliable. This method seemed to lack sensitivity. This may have been due to the short time the cotton cloth was exposed to the water.*

*Optical brighteners could be present in high concentrations in effluent, but bacterial counts could be very low if the effluent was properly disinfected before being discharged from wastewater treatment plants or aerobic onsite systems. Therefore, high optical brightener readings may not indicate high bacterial counts. Effluent from traditional onsite septic systems and raw sewage may have high bacterial counts along with high optical brightener concentrations.*

*A number of variables like disinfection processes, UV exposure, dilution rates and the potential source of the effluent must be considered when attempting to determine a correlation between high bacterial counts and the presence of optical brighteners. Identifying effluents and waters that have been contaminated with or come in contact with human effluents may be a more appropriate use of optical brighteners and a handheld fluorometer for city personnel trying to determine if anthropogenic sources have contaminated a surface water. The handheld fluorometer was easy to use, gave quick results, and allowed the screening of many samples in a short period of time which made it a useful field instrument to help detect the presence of human derived wastewater.*

# APPENDIX F

# RESPONSE TO COMMENTS

## Comments from U.S. EPA received on June 03 and June 10, 2011:

**Comment 1:** Section 4.4, page 4-5, step 3, second paragraph, Remove the second sentence and reword the third sentence to, This LDC 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).

***Response #1:*** *Change made as suggested.*

**Comment 2:** Section 5.6 on MOS, remove the generic statements on MOS which are sentences three and four. Those sentences are corrected [sic] placed in section 4 in the discussion of options for MOS. The section 5 text should be addressing how these TMDLs were calculated.

***Response #2:*** *This comment concerns how text is formatted in the report and is not a substantive comment. This language has been used in all previous approved TMDL reports. We will consider modifying the text as suggested in future similar TMDL reports. No changes were made.*

**Comment 3:** The stormwater permit numbers for the 5 permits need to be included in text or a table.

***Response #3:*** *Permit numbers added on Pages 3-7 and 3-8 in the parentheses next to the city names.*

**Comment 4:** There is a line about the percent reductions being informational in the document.

Section 5.7 conflicts with that statement.

Section 5.7, the second paragraph, remove the sentence, "For each stream segment the TMDLs presented in this report are expressed as a percent reduction across the full range of flow conditions."

***Response #4:*** *Sentence removed as suggested.*

## Comments from K.T. "Hutke" Fields – Natchez Nation received on May 18, 2011:

Perhaps we should enforce already established legal guidelines?! There should be significant consequences for consistently failing to meet standards.

1) Private residences...their cleanliness...the amount of waste from animal or mineral sources.

2) Keep watch on farm/ranch waste.

***Response:*** *As stated on Page vi, "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". In addition, state agencies, including the ODEQ, carry out enforcement actions based on current rules and regulations on regulated sources of pollution, such as NPDES permittees and CAFO operations. However, many sources, such as non-CAFO commercial farm animal operations and private residences, are not regulated by the State. Voluntary pollution control measures and local ordinances, if any, can be used to prevent or minimize impact from those sources.*

## Comments from Mike Thralls – Oklahoma Conservation Commission received on May 16, 2011:

With 923 SSO's reported it would seem that "Although infrequent" should be removed from the sentence describing the impact of SSO. As an observing [sic] it seems Canadian Geese and their whit [sic] geese cousins are having a growing impact on urban watersheds and perhaps should be considered.

***Response:*** *The 923 incidents spread over 3 areas in 5 years. In addition, because the exact locations of the SSOs were not mapped, it is not clear all these 923 SSOs took place in areas contributing to the impaired waterbodies. Furthermore, the 3 facilities, to which these SSOs were attributed, have a combined design flow capacities of over 51 million gallons, while the vast majority (97%) of the SSOs had an overflow amount below 0.5 million gallons. Therefore, we believe it's reasonable to regard these SSOs as infrequent events.*

*Canada Geese and other waterfowl can be an important source of bacteria loading to urban waterways. However, there are no reliable population survey data for ODEQ to quantify the number of birds present or the potential loading.*