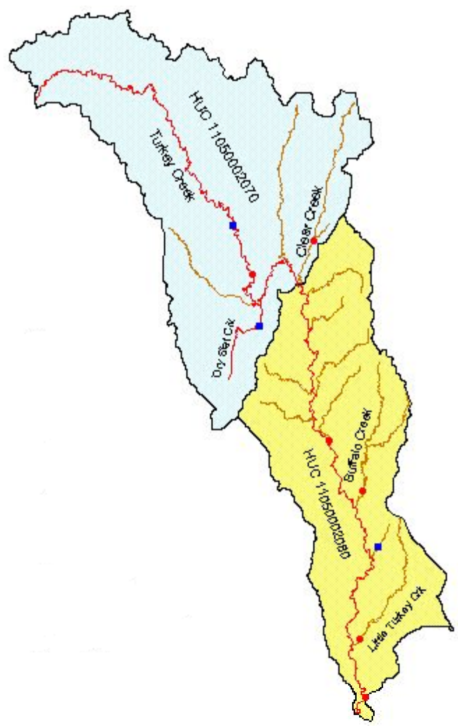
TMDL Development

For

Turkey Creek HUC 11 Watersheds

Final Report



Developed By
Oklahoma Department of Environmental Quality
September 19, 2006

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1. BACKGROUND

Turkey Creek, a tributary of the Cimarron River, is located in north central Oklahoma and is about 83 miles long from its headwater to the Cimarron River. Turkey Creek flows in four counties: Alfalfa, Garfield, Kingfisher, and Major (Figure 1-1). Turkey Creek watershed consists of two HUC 11 watersheds: 11050001070 (Upper Turkey Creek) and 11050002080 (Lower Turkey Creek).

Turkey Creek watershed is approximately 226,500 acres. According to the land use database from BASINS, the Turkey Creek watershed is primarily agricultural (98.5%). The remaining land use is urban (0.78%), forest (0.49%), or other 0.23%. The common soil series is mainly silt loam with some loamy fine sand and fine sandy loam. The streams in this watershed are frequently plowed to the stream bank and the smallest watercourses are plowed over [5]. The riparian ecosystem is degraded in many areas, mainly as a result of farming and grazing practices. Lack of a buffer zone of riparian vegetation along some reaches of the creek contributes to excess sedimentation and high nutrient levels [6].

A 1988 section 319 assessment report completed by the Oklahoma Conservation Commission (OCC) identifies the upper Cimarron Water Quality Management section as threatened by agricultural sources. Degraded water quality in Turkey Creek is primarily the result of elevated levels of suspended solids and nutrients associated with soil erosion.

Turkey Creek, Little Turkey Creek, Buffalo Creek and Clear Creek are listed in the Oklahoma 2002 303(d) list for pathogens and turbidity impairments. Little Turkey Creek and Buffalo Creek are also listed in the 2002 303(d) list for low dissolved oxygen impairment. Lower Turkey Creek is identified as Category 1 (in need of restoration) in Oklahoma's Unified Watershed Assessment and is ranked in the top 15 watersheds. However, since both watersheds contain 303(d) listed streams, it was proposed that both watersheds be addressed in one TMDL study.

There is no major discharger in the watershed. There are three minor municipal wastewater discharges: the cities of Lahoma, Hennessy, and Drummond. There are no poultry houses or other permitted Concentrated Animal Feeding Operations (CAFO) in the watershed.

The water quality data used in this TMDL study was collected by the OCC. There are three monitoring sites on Turkey Creek and one site each on Little Turkey Creek, Buffalo Creek, and Clear Creek. Flow monitoring was conducted only at the lower end of Turkey Creek from October 2003 to October 2005.

The TMDLs for Turkey Creek were developed using the Load Duration Curve method. There was no daily flow data available for any streams in the Turkey Creek watershed during the period when water quality samples were collected. An HSPF (Hydrologic Simulation Program Fortran) model was calibrated and the predicted stream flows were used to develop flow and load duration curves in this TMDL study.

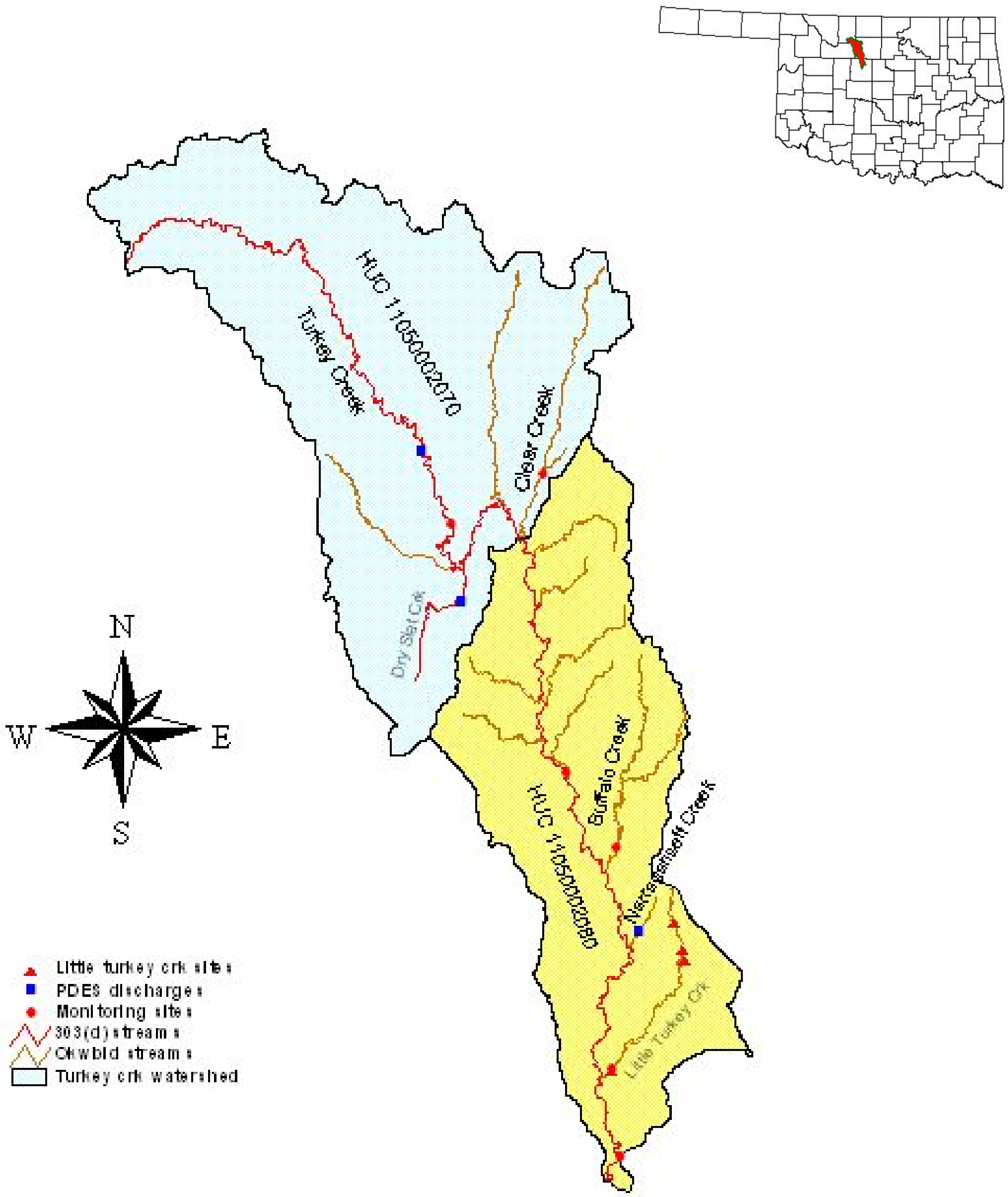

FIGURE 1-1. TURKEY CREEK WATERSHED STUDY AREA

2. PROBLEM STATEMENT

Under Section 303(d) of the Clean Water Act, states are required to develop lists of impaired waters which do not meet water quality standards. States must establish priority rankings for waters on the list and develop Total Maximum Daily Loads (TMDLs) for listed waters. TMDLs state the maximum amount of pollutants in treated wastewater that can safely be discharged into a water body without adversely affecting its quality. TMDLs allocates pollutant loadings among point and nonpoint pollution sources.

The original work plan for this project was intended to address the pollutants listed in the Oklahoma 1998 303(d) list. Table 2-1 is an excerpt from the 1998 303(d) list, which contains particular pollutants suspected of causing impairment to the waterbodies in the Turkey Creek watershed. All the waterbodies in Table 1 are ranked as Priority 3 waterbodies. The waters on the 303(d) list are also considered Category 5 on a scale of 1 to 5 where Category 1 are the ones that attain all their beneficial uses and Category 5 are the ones that are do not meet their beneficial uses because of pollution so TMDLs are required. Within Category 5, there are priorities with Priority 1 waters being the most threatened and/or impaired and Priority 4 the least in that Category.

TABLE 2-1: 1998 303(d) LIST FOR TURKEY CREEK

Causes / Water Bodies	Nutrients	Siltation	Suspended Solids	Dissolved Oxygen
Turkey Creek (OKWBID# 620910060010)	X	X	X	
Dry Salt Creek (OKWBID# 620910060140)				X

Dry Salt Creek is the receiving stream of the City of Drummond wastewater treatment facility. The 303(d) list indicates that the Dissolved Oxygen (DO) impairment is caused by wastewater discharges. A new wasteload allocation was performed for the City of Drummond wastewater treatment facility to ensure DO standards were met in Dry Salt Creek. Dry Salt Creek was not listed in the Oklahoma’s 2002 303(d) list.

The 1998 303(d) list is widely recognized as being not based on data adequate to meet current protocols and not developed utilizing a consistent methodology. The status of each entry in the 1998 303(d) list has been reevaluated in the 2002 Integrated Water Quality Assessment Report [3]. The nutrient impairment is listed in error as threatened and no impairment is expected in the next two years. Siltation and suspended solids are listed in error based on high flow turbidity sampling. The Oklahoma Water Quality Standards (OWQS) limits the application of turbidity criteria to base flow condition.

In addition, the 2002 Integrated Water Quality Assessment Report adds pathogens and turbidity impairments to the 2002 303(d) list for Turkey Creek, Little Turkey Creek, Buffalo Creek and Clear Creek (Table 2-2). Low dissolved oxygen impairment has also been added to the 2002 303(d) list for Little Turkey Creek and Buffalo Creek. Data supporting the 2002 303(d) list will be presented in Section 5 below.

TABLE 2-2: 2002 IMPAIRMENT STATUS FOR STREAMS IN TURKEY CREEK WATERSHED

Streams	OKWBID#	Length (mi)	Low DO	Turbidity	Pathogens	Category
Turkey Creek	OK620910060010	83		**X**	**X**	5
Little Turkey Creek	OK620910060020	11	**X**	**X**	**X**	5
Buffalo Creek	OK620910060030	14	**X**	**X**	**X**	5
Clear Creek	OK620910060110	5		**X**	**X**	5
Narraqansett Creek	OK620910060025	4				3
Bison Creek	OK620910060040	6				3
Hell and Gone Creek	OK620910060050	7				3
Barr Creek	OK620910060060	6				3
Dry Creek	OK620910060070	8				3
Flowing Creek	OK620910060080	5				3
Sand Creek	OK620910060090	4				3
Spring Creek	OK620910060100	7				3
Sand Creek	OK620910060120	10				3
Carrier Creek	OK620910060130	13				3
Dry Salt Creek	OK620910060140	7				3
Elm Creek	OK620910060150	9				3

Since the causes of impairments for Turkey Creek and its tributaries have been changed, the TMDL study for the watershed must be modified accordingly. This TMDL will address turbidity and pathogens impairments.

A TMDL was not calculated for low DO because DO impairment was not part of the commitment in the original work plan. However, the status of the DO impairment was reevaluated with the monitoring data, including newly available data. The data shows that Little Turkey Creek is not impaired for DO. The beneficial use is partially supported with regard to DO in Buffalo Creek. We believe that once pollution from non-point sources is reduced through the Best Management Practices (BMPs), the dissolved oxygen concentration in Buffalo Creek will be improved.

Turkey Creek is designated in Oklahoma Water Quality Standards for the following beneficial uses:

- Public and Private Water Supply
- Warm Water Aquatic Community
- Agriculture
- Industrial & Municipal Process and Cooling Water
- Primary Body Contact Recreation
- Aesthetics

Little Turkey Creek, Buffalo Creek and Clear Creek do not have designated beneficial uses in Oklahoma Water Quality Standards. Warm Water Aquatic Community (WWAC) and Primary Body Contact Recreation (PBCR) beneficial uses are assumed for these streams. WWAC beneficial use is related to dissolved oxygen and turbidity standards and PBCR beneficial use is related to bacteria standards. We do not make assumptions of other types of beneficial uses since they have no impact on the assessment of impairment status for streams and on the outcome of this TMDL study.

3. SOURCES ANALYSIS

3.1 POINT SOURCES

There are three permitted wastewater discharges in Turkey Creek watershed. The square dots in Figure 1-1 mark the locations of the discharges. The three discharges are:

Town of Lahoma:

Receiving stream: Turkey Creek
Design Flow: 0.075 millions of gallons per day (MGD)
Discharging Limits: Lagoon Secondary [30 mg/L 5-day biochemical oxygen demand (BOD_5), 90 mg/L total suspended solids (TSS).]

Drummond Public Works Authority

Receiving stream: Dry Salt Creek, Tributary to Turkey Creek
Design Flow: 0.08 MGD
Discharging Limits: Lagoon Secondary (30 mg/L BOD_5, 90 mg/L TSS).

Town of Hennessey

Receiving stream: Narragansett Creek, Tributary to Turkey Creek
Design Flow: 0.33 MGD
Discharging Limits: **June – October:** No Discharge **or**
10 mg/l $CBOD_5$
15 mg/l TSS
4 mg/l ammonia (NH_3-N)
4 mg/l minimum DO

March – May: No Discharge **or**
12 mg/l $CBOD_5$

15 mg/l TSS
6 mg/l NH_3-N
4 mg/l minimum DO

Nov. – February: Lagoon Secondary (30 mg/L BOD_5, 90 mg/L TSS).

The Lagoon Secondary limits also include implicit Ammonia (NH_3-N) limits of 7.2 mg/L for the spring and summer and 15.4 mg/L for the winter. There is no phosphorus limit on any of these three facilities.

These point source discharges are believed to have minimum impact on turbidity impairment of Turkey Creek because the surrogate being used for turbidity (TSS) is considered to represent inorganic suspended solids (i.e., soil and sediment particles from erosion or sediment resuspension). The suspended solids discharged by point sources in the Turkey Creek watershed are assumed to consist primarily of organic solids rather than inorganic solids. Discharges of organic suspended solids from point sources are already addressed by ODEQ through their permitting of point sources to maintain water quality standards for dissolved oxygen. The waste load allocations (WLAs) to support these TMDLS will not require any changes to the permits concerning inorganic suspended solids. Therefore, future growth for these permits or new permits would not be restricted by these turbidity TMDLs.

Fecal coliform limits are not required currently in Oklahoma municipal discharge permit for lagoon systems. However, because the receiving streams of the above facilities are impaired with regard to pathogens, fecal coliform limits will be recommended for those facilities.

3.2 Non-point Sources

Since the agricultural and grazing land comprise more than 98% of the watershed area, lack of riparian vegetation along some reaches in these areas contributes to excess sedimentation and high nutrient levels, especially during high flow events. Figure 3-1 shows the land uses in the Turkey Creek watershed and Table 3-1 summarizes the area and percentage of each land use.

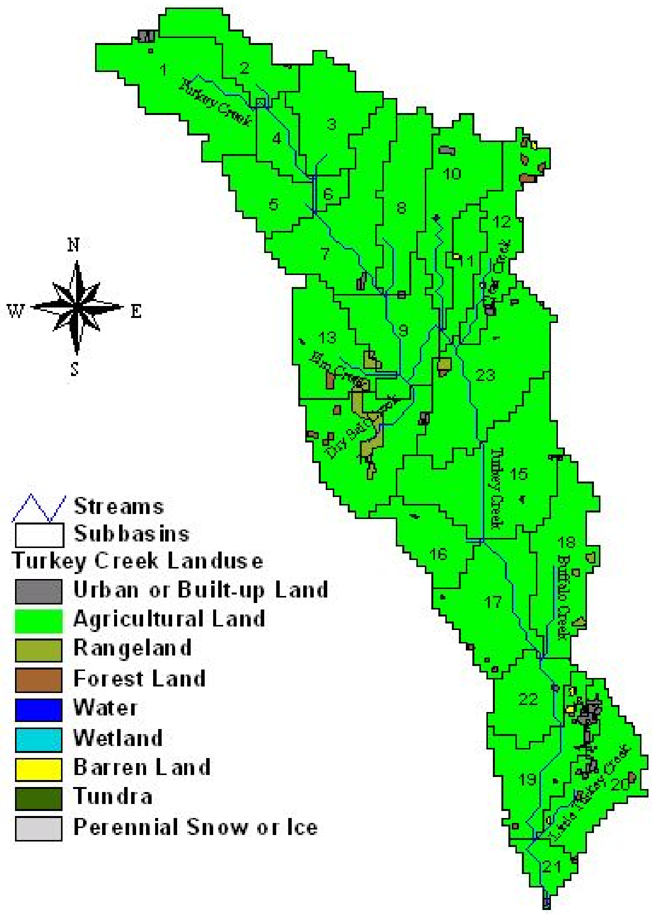

FIGURE 3-1. LAND USES IN TURKEY CREEK WATERSHED

TABLE 3-1: LAND USES IN THE TURKEY CREEK WATERSHED

Land Uses	Area (Acres)	Percentage
Agricultural Land	220970	97.56%
Urban or Built-up Land	1770	0.78%
Range Land	2251	0.99%
Forest Land	1115	0.49%
Water	98	0.04%
Barren Land	304	0.13%
Total	226508	100%

The data shows that turbidity and pathogens are very high during high flow events. The phosphorus level is also very high during high flow events because majority of total phosphorus (TP) is attached to sediments. If sediment in runoff can be reduced, all turbidity, suspended solids, and nutrients will be reduced.

Table 3-2 shows the minimum, maximum, and median total phosphorus values of the monitoring data from November 1997 to July 1999.

TABLE 3-2: TURKEY CREEK TOTAL PHOSPHORUS STATISTICS

Sites / TP (mg/L)	Upper Turkey Crk	Middle Turkey Crk	Lower Turkey Crk
Minimum	0.144	0.147	0.182
Median	0.336	0.3065	0.399
Maximum	2.48	1.804	1.83

As shown in the above table, the maximum TP concentration is as much as seven times greater than the median. High TP concentrations are coincident with high flow events.

Since the watershed is primarily agricultural land, non-point sources are believed to be the major sources for turbidity and pathogens. Due to the lack of data to establish the background condition for TSS/turbidity and fecal coliform, separating out background loading from nonpoint sources is not feasible in this TMDL development.

4. OKLAHOMA WATER QUALITY STANDARDS/CRITERIA

To verify the status of impairment for the streams in the Turkey Creek watershed, available monitoring data must be compared with the applicable Oklahoma water quality standards. This section presents water quality standards for nutrients, pathogens, turbidity and dissolved oxygen.

4.1 NUTRIENT CRITERIA

The Oklahoma Water Quality Standards (OWQS) do not have numerical criteria for nutrients that apply to the streams in Turkey Creek Watershed. However, they contain the following narrative standard which applies to all streams and lakes in the state:

> "**785:45-5-19 (c) (2) Nutrients**. Nutrients from point source discharges or other sources shall not cause excessive growth of periphyton, phytoplankton, or aquatic macrophyte communities which impairs any existing or designated beneficial use".

The rules for implementation of Oklahoma's Water Quality Standards (OAC 785-46-15) [4] provide a framework which is used in assessing threats or impairments to beneficial uses and waterbodies and watersheds caused by nutrients. The implementation rules describe a dichotomous process to be used in determining whether a stream is nutrient-threatened. If the dichotomous process indicates a stream is not threatened by nutrients, the stream will be considered not impaired by nutrients.

The dichotomous process uses the follow factors to determine if a stream is threatened by nutrients:

- Stream order
- Stream slope
- Total-P concentration
- Nitrate plus nitrite concentration
- Canopy shading
- Turbidity

The application of this dichotomous process to streams in Turkey Creek watershed was utilized to derive the threshold concentrations for Total-P and nitrate plus nitrite. If the mean value of Total-P and nitrate plus nitrite samples in a stream is below their corresponding threshold value, the stream is considered not threatened by nutrients.

Table 4-2 shows stream order, slope and the threshold values for Total-P and nitrate plus nitrite for streams in the Turkey Creek watershed.

TABLE 4-2: THRESHOLD VALUES FOR TOTAL-P, NO_2+NO_3 AND TURBIDITY

Stream	Stream Order	Slope (ft/mile)	Total-P (mg/L)	$NO_2 + NO_3$ (mg/L)	Turbidity (NTU)
Upper Turkey Creek	2	<17	0.15	2.40	20
Middle Turkey Creek	4	<17	0.36	5.00	20
Lower Turkey Creek	4	<17	0.36	5.00	20

4.2 TURBIDITY CRITERIA

According to the Oklahoma Water Quality Standards (785:45-5-12(f)(7)), the turbidity criterion for streams with WWAC beneficial use is 50 Nephelometric Turbidity Unit (NTU).

The turbidity of 50 NTU applies only to seasonal base flow conditions. Elevated turbidity level may be expected during, and for several days after, a storm event.

4.3 DISSOLVED OXYGEN CRITERIA

The Oklahoma Water Quality Standards (OWQS) has the following dissolved oxygen criteria for streams designated for Warm Water Aquatic Community beneficial use:

Summer (Jun 16 – Oct 15): 4 mg/L
Seasonal (Oct 16 – Jun 15): 5 mg/L

The dissolved oxygen criteria must be maintained at all times.

4.4 FECAL COLIFORM CRITERIA

According to Oklahoma Water Quality Standards (785:45-5-16(c)), the bacteria of the fecal coliform group shall not exceed a monthly geometric mean of 200/100 ml, as determined by multiple-tube fermentation or membrane filter procedures based on a minimum of not less than five (5) samples collected over a period of not more than thirty (30) days. Further, in no more than 10% of the total samples during any thirty (30) day period shall the bacteria of the fecal coliform group exceed 400/100 ml.

Fecal coliform samples were collected in Turkey Creek, Little Turkey Creek, Buffalo Creek, and Clear Creak. Since samples were collected only once a month, there was not enough data to calculate monthly geometric mean. Therefore, geometric mean of fecal coliform was calculated using all samples. The PBCR beneficial use shall be considered attained if geometric mean of all samples is less than or equal to 200/100ml and no more than 10% of the fecal coliform samples exceed 400/100ml.

5. MONITORING DATA AND IMPAIRMENT STATUS

The water quality data in this study was collected by Oklahoma Conservation Commission from November 1997 to July 1999 and from April 2001 to March 2002. It was assumed in the Work Plan that no additional water quality monitoring would be required for this study.

Monthly water quality data were collected from 1997 through 1999 at three sites on Turkey Creek (Upper, Middle and Lower) and in three major tributaries of Turkey Creek (Clear Creek, Buffalo Creek and Little Turkey Creek).

The locations of the monitoring sites are shown in Figure 1-1. The legal descriptions of the monitoring sites are listed in the following table.

TABLE 5-1: TURKEY CREEK WATERSHED MONITORING SITES

Site	Latitude	Longitude	Legal	County
Turkey Creek (Upper)	36° 20' 50.4"	98° 03' 23.2"	NB, S33, T22N, R8W	Garfield
Turkey Creek (Middle)	36° 13' 04.0"	97° 59' 07.1"	NB, S18, T20N, R7W	Garfield
Turkey Creek (Lower)	35° 58' 43.0"	97° 55' 22.0"	NW, S2, T17N, R7W	Kingfisher
Clear Creek	36° 22' 35.3"	97° 59' 25.9"	NB, S19, T22N, R7W	Garfield
Buffalo Creek	36° 09' 34.3"	97° 55' 46.9"	NB, S3, T19N, R7W	Kingfisher
Little Turkey Creek	36° 01' 47.4"	97° 55' 47.5"	NE, S22, T18N, R7W	Kingfisher

Among all of the monitoring parameters, nutrients, turbidity, total suspended solids, bacteria and dissolved oxygen will be discussed in the section.

Additional monitoring was conducted at three sites on the upper part of Little Turkey Creek during 2001 and 2002. The locations of these sites are also shown in Figure 1-1.

The data used in this TMDL is accepted at face value. Date was collected in accordance with the monitoring agency's QA/QC.

5.1 NUTRIENTS

Turkey Creek is no longer listed as impaired for nutrients in the 2002 303(d) list. A TMDL calculation was not performed for nutrients. However, since nutrients are listed as pollutants for Turkey Creek in the 1998 303(d) list, nutrient data should be evaluated in this report.

The dichotomous process specified in the Use Support Assessment Protocol (785:46-15-10) [2] is used to determine if Turkey Creek is threatened by nutrients. If the data show that Turkey Creek is not threatened by nutrients, it is certainly not impaired by nutrients.

Stream order must be determined first in order to use the dichotomous process. Figure 5-1 shows the stream order of Turkey Creek. The Upper Turkey Creek monitoring station is located in the 3rd order segment. Both Middle and Lower Turkey Creek stations are located in the fourth order segment.

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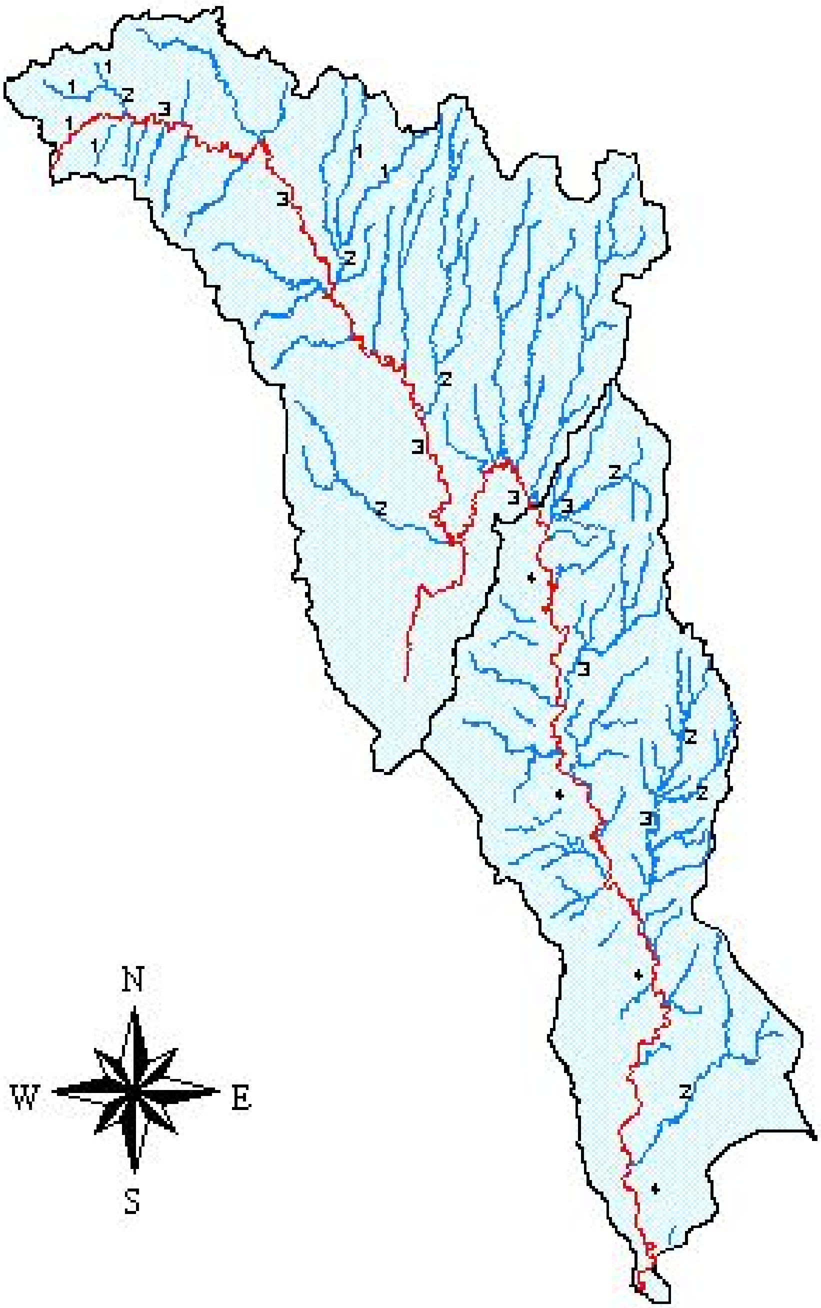


FIGURE 5-1. TURKEY CREEK STREAM ORDER

Based on the monitoring data from the middle and lower Turkey Creek stations, the median values of nitrate/nitrite and TP concentrations are 1.85 mg/L and 0.33 mg/L, respectively, which are below the threshold median values of 5.0 mg/L and 0.36 mg/L. The middle and lower Turkey Creek segments are not threatened and therefore not impaired

The median values of nitrate/nitrite and TP concentrations from the upper Turkey Creek station are 1.94 mg/L and 0.40 mg/L. The median value of nitrate/nitrite is below the threshold median value of 2.4 mg/L, but the median value of TP exceeds the threshold value of 0.15 mg/L. According to the dichotomous process, turbidity data at seasonal base flow conditions need to be evaluated. If turbidity measurements under the base flow condition are above the threshold value of 20 NTU, the stream is not considered as nutrients threatened even though nitrate/nitrite or TP concentrations exceed the corresponding threshold value.

TABLE 5-2: TURBIDITY AT LOW FLOW EVENTS (UPPER TURKEY CREEK)

Date	Flow (cfs)	Turbidity (NTU)
6/16/1998	6.98	46.2
7/16/1998	4.85	69.2
7/22/1998	2.72	35.8
8/18/1998	2.32	174
9/29/1998	2.05	89.5
10/26/1998	8.04	72

There are 14 monthly flow measurements in the Upper Turkey Creek. Table 5-2 shows the turbidity data collected under the six lowest flow measurements. These flows should represent the base flow condition for the upper end of Turkey Creek. All turbidity measurements are above the threshold value of 20 NTU. According the dichotomous process, the Upper Turkey Creek is not threatened by nutrients.

In sum, Turkey Creek is neither threatened nor impaired by nutrients, though the phosphorus level is elevated in the upper segment of the creek. The nutrient impairment should be removed from the 1998 303(d) list. In addition, DO data seems to support this assessment. The DO measurements in Turkey Creek are above the screen values and are within the normal DO range.

5.2 TURBIDITY

Turbidity is a measure of water clarity and is caused by particles suspended in the water column. Turbidity measurement can be affected by a number of factors. Suspended solids, algae and true color could all have a significant impact on turbidity measurements. True color is also a measure of water clarity. It is not a component of turbidity but affects the measurement of turbidity.

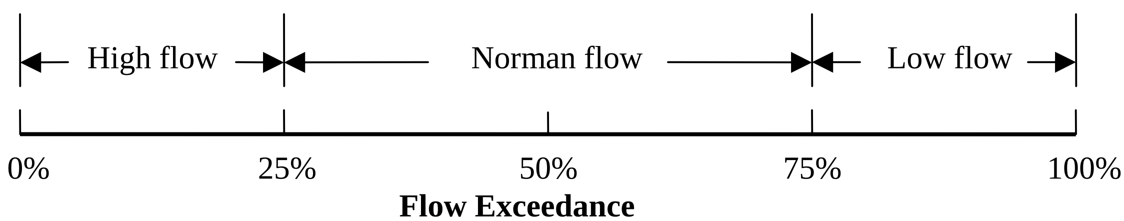
The target value for turbidity is 50 NTU under seasonal base flow condition. Turbidity samples taken during or shortly after a storm event should be excluded from the assessment of turbidity impairment status.

5.2.a Turkey Creek

Turbidity for Turkey Creek was added to the Oklahoma's 2002 303(d) list based on the assessment in the 2002 Integrated Water Quality Assessment Report [3]. When the assessment was made, there was not enough flow data to establish a seasonal base flow. Therefore, the impairment status was assessed solely based on the percentage of samples exceeding the turbidity target under all flow conditions.

As shown in Table 10-1, there are a total of 57 turbidity samples collected in Turkey Creek. Twenty-one (21) or 36.8% samples exceeded the target value of 50 NTU. As the result, Warm Water Aquatic Community beneficial use for Turkey Creek was considered impaired with regard to turbidity. It is worth to note that this assessment is very conservative and may not be accurate because turbidity standards only apply under seasonal base flow conditions and the assessment did not consider the flow conditions when the samples were collected.

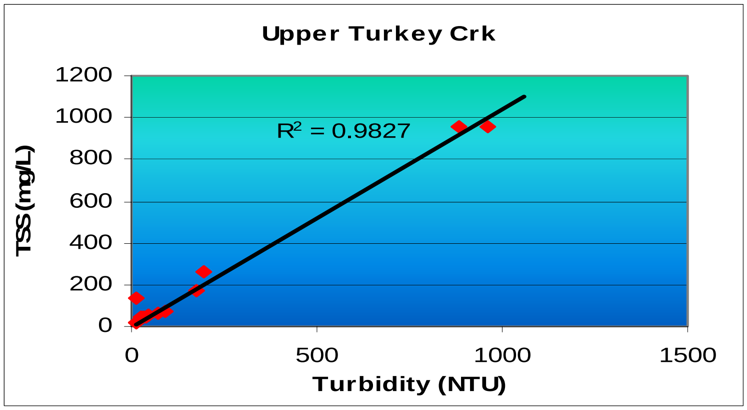
Flow data was collected in the lower end of Turkey Creek from October 2003 through October 2005. With this newly available flow data, an HSPF model was calibrated for the Turkey Creek watershed in this TMDL study. The measured flow was used to develop a flow duration curve in Turkey Creek and the predicted flow was used develop flow duration curve in Little Turkey Creek, Buffalo Creek and Clear Creek. The predicted flow was also used to determine the flow conditions when turbidity samples were collected. The flow conditions were defined as follows:

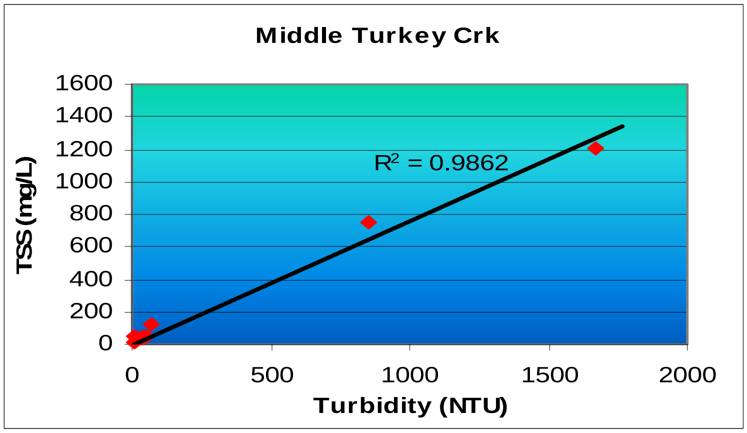


High flow in the stream is a result of storm events. Turbidity standards only apply to base flow condition. Therefore, if a turbidity sample was collected at the high flow condition (flow exceedance of 25% or less), the sample should not be used to determine the impairment status regarding turbidity.

When turbidity samples in high flow events were excluded, Turkey Creek was still considered impaired with regard to turbidity.

The correlation of turbidity and total suspended solids (TSS) was evaluated in this section. Since turbidity is explained by suspended solids, algae and true color, the more turbidity is explained by suspended solids, the less turbidity is explained by algae and true color.





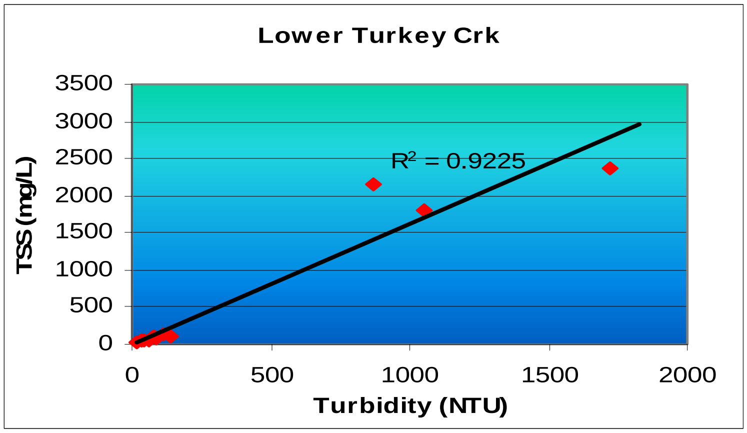


FIGURE 5-2. CORRELATION BETWEEN TURBIDITY AND TSS AT DIFFERENT SITES

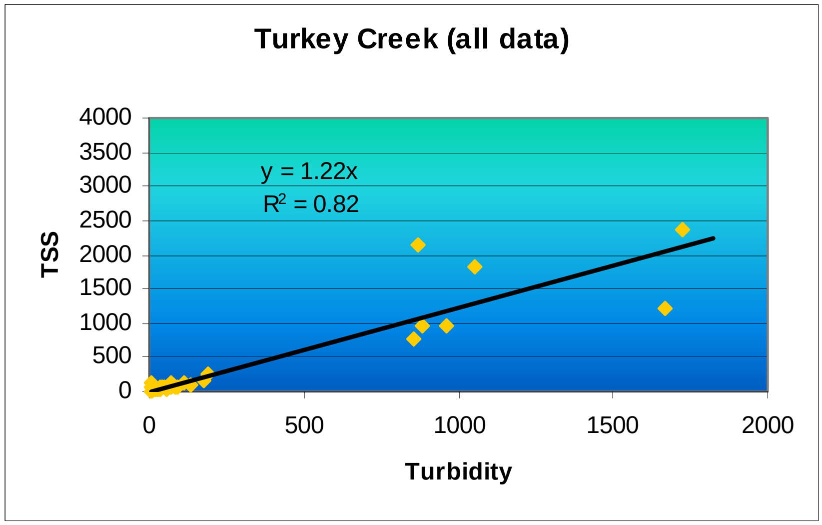


FIGURE 5-3. CORRELATION BETWEEN TURBIDITY AND TSS IN TURKEY CREEK

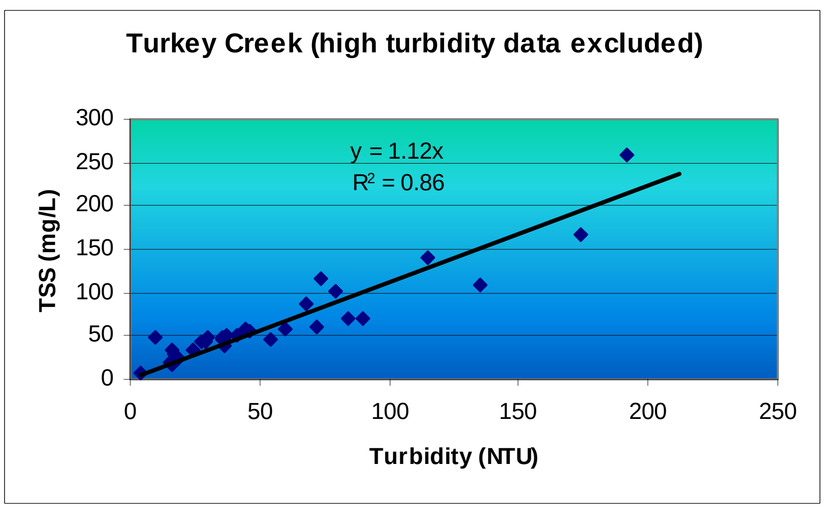


FIGURE 5-4. CORRELATION BETWEEN TURBIDITY AND TSS IN TURKEY CREEK WHEN HIGH TURBIDITY DATA ARE EXCLUDED

Figure 5-2 shows the correlation between turbidity and TSS at three monitoring sites, upper, middle and lower Turkey Creek. The R^2 for the three monitoring sites ranges from 0.92 to 0.99, which indicates that turbidity in Turkey Creek is almost exclusively explained by suspended solids. These high R^2 values may not be real for a natural stream and the statistics are often skewed by only a couple of very high turbidity measurements. According to the predicted flows by the HSPF model, those high turbidity measurements are all associated with high flow events under which turbidity standards do not apply. Therefore, it is best to exclude those very high turbidity data in the correlation between turbidity and TSS in this study.

Figure 5-3 shows the correlation between turbidity and TSS using all data collected in Turkey Creek. As shown on Figure 5-3, the turbidity data can be divided into two distinct groups: less than 200 NTU and greater than 800 NTU. We know that all turbidity measurements in the higher turbidity group are associated with high flow events. Therefore, it was decided that all data points greater than 200 NTU were excluded from regression.

Figure 5-4 shows the turbidity and TSS relationship after high turbidity data were excluded. This relationship will be used in the TMDL calculations. The R^2 is 0.86 which is considered to be very good for natural systems. The p-value is 3.3×10^{-20} which means there is only 3.3 out of 10^{20} chance that turbidity is not related to TSS. With such strong correlation between turbidity and TSS in Turkey Creek, we are confident of using TSS as a surrogate measure in the turbidity TMDL calculations.

5.2.b Little Turkey Creek

Turbidity for Little Turkey Creek was added to the Oklahoma's 2002 303(d) list based on the assessment in the 2002 Integrated Water Quality Assessment Report [3]. Due to the lack of flow data, the impairment status was assessed solely based on the percentage of samples exceeding the turbidity target under all flow conditions.

As shown in Table 10-2 there are a total of 39 turbidity samples collected in Little Turkey Creek. Eleven (11) or 28% samples exceeded the target value of 50 NTU. As a result, Warm Water Aquatic Community beneficial use for Little Turkey Creek was considered impaired with regard to turbidity and turbidity impairment was added to the 2002 303(d) list for Little Turkey Creek.

An HSPF model was calibrated for the Turkey Creek watershed in this TMDL study. The predicted flow in Little Turkey Creek was used to determine the flow conditions when turbidity samples were collected. When the samples collected under high flow events were excluded, 19% or six (6) out of 32 samples were greater than the target value of 50 NTU. Therefore, we can conclude that Little Turkey Creek is impaired with regard to turbidity.

Figure 5-5 shows the regressions between turbidity and TSS for Little Turkey Creek with high turbidity data excluded. This relationship will be used in the TMDL calculations for Little Turkey Creek.

5.2.c Buffalo Creek

Turbidity for Buffalo Creek was added to the Oklahoma's 2002 303(d) list based on the assessment in the 2002 Integrated Water Quality Assessment Report.

As shown in Table 10-2 there are a total of 19 turbidity samples collected in Turkey Creek. Eight (8) or 42% samples exceeded the target value of 50 NTU. As a result, Warm Water Aquatic Community beneficial use for Buffalo Creek was considered impaired with regard to turbidity and turbidity impairment was added to the 2002 303(d) list for Little Turkey Creek.

When the samples collected under high flow events (percent of flow exceedance of 25% or less) were excluded, 40% or six out of 15 samples were greater than the target value of 50 NTU. Therefore, we can conclude that Buffalo Creek is impaired with regard to turbidity.

Figure 5-5 also shows the regressions between turbidity and TSS for Buffalo Creek with high turbidity data excluded. This relationship will be used in the TMDL calculations for Buffalo Creek.

5.2.d Clear Creek

Turbidity for Clear Creek was added to the Oklahoma's 2002 303(d) list based on the assessment in the 2002 Integrated Water Quality Assessment Report.

As shown in Table 10-2 there are a total of 20 turbidity samples collected in Clear Creek. Four (4) or 20% samples exceeded the target value of 50 NTU. As the result, Warm Water Aquatic Community beneficial use for Clear Creek was considered impaired with regard to turbidity and turbidity impairment was added to the 2002 303(d) list for Little Turkey Creek.

When the samples collected under high flow events were excluded, the remaining turbidity samples were all less than the target value of 50 NTU. Therefore, we can conclude that Clear Creek is not impaired with regard to turbidity and should be removed from the 303(d) list for this pollutant.

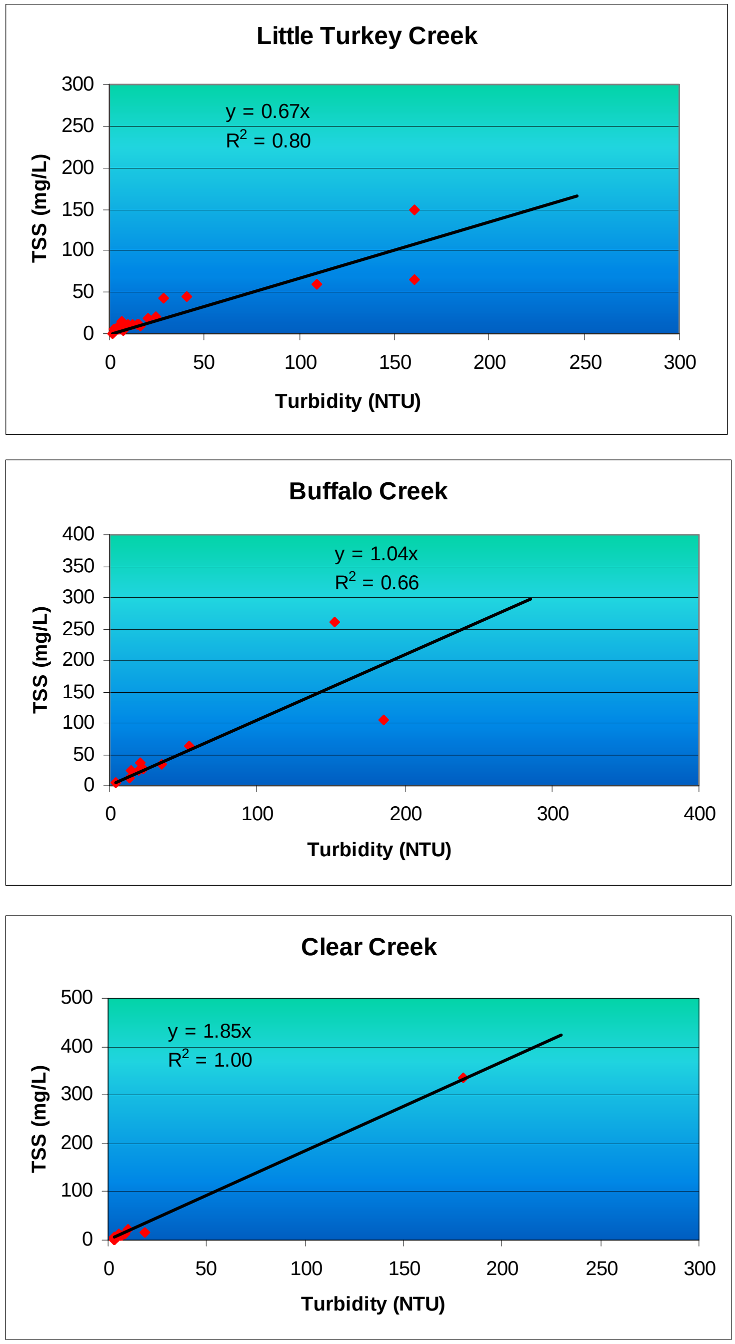


FIGURE 5-5. REGRESSIONS BETWEEN TURBIDITY AND TSS FOR LITTLE TURKEY CREEK, BUFFALO CREEK AND CLEAR CREEK (HIGH TURBIDITY DATA EXCLUDED)

5.3 BACTERIA

Bacteria criteria apply to all flow conditions. Pathogen impairment was added to the 2002 303(d) list for Turkey Creek, Little Turkey Creek, Buffalo Creek and Clear Creek based on the assessment in the 2002 Integrated Water Quality Assessment Report.

5.3.a Turkey Creek

The geometric mean of all fecal coliform samples in Turkey Creek is 645 colonies per 100 ml, greater than the screening value of 200/100 ml. In addition, 39% of the samples (7 out of 18 samples) are greater than the screening value 400/100 ml. According to the USAP, Turkey Creek is impaired by fecal coliform.

5.3.b Little Turkey Creek

The geometric mean of all fecal coliform samples in Little Turkey Creek is 705 colonies per 100 ml, greater than the screening value of 200/100 ml. In addition, 44% of the samples (8 out of 18 samples) are greater than the screening value 400/100 ml. According to the USAP, Little Turkey Creek is impaired by fecal coliform.

5.3.c Buffalo Creek

The geometric mean of all fecal coliform samples in Buffalo Creek is 636 colonies per 100 ml, greater than the screening value of 200/100 ml. In addition, 41% of the samples (9 out of 22 samples) are greater than the screening value 400/100 ml. According to the USAP, Buffalo Creek is impaired by fecal coliform.

5.3.d Clear Creek

The geometric mean of all fecal coliform samples in Clear Creek is 1227 colonies per 100 ml, greater than the screening value of 200/100 ml. In addition, 78% of the samples (14 out of 18 samples) are greater than the screening value 400/100 ml. According to the USAP, Clear Creek is impaired by fecal coliform.

5.4 DISSOLVED OXYGEN

Three out of eighteen samples (16.7%) in Buffalo Creek are less than the screening values. The Fish and Wildlife Propagation beneficial use in Buffalo Creek is partially supported and is considered as impaired with regard to DO.

Three out of thirty-two samples or 9.4% of the samples in Little Turkey Creek are less than the screening values. The Fish and Wildlife Propagation beneficial use is fully supported in Little Turkey Creek. In other words, Little Turkey Creek (OKWBID# 620910060020) is not impaired with regard to dissolved oxygen and should be removed from the 303(d) listing for this pollutant.

Dissolved oxygen samples in Turkey Creek and Clear Creek are all above the screening values. Therefore, the Fish and Wildlife Propagation beneficial use is fully supported in Turkey Creek and Clear Creek.

6. TMDL TARGETS

6.1 TURBIDITY STANDARDS

The applicable turbidity standard for Turkey Creek is 50 NTU as stated in the Oklahoma Water Quality Standards (785:45-5-12) [1]. This criterion only applies at the seasonal base flow conditions. A stream shall be deemed to be fully supported regarding turbidity, if 10% or less of samples exceed 50 NTU.

TSS is chosen as an indicator for turbidity impairment. Turbidity standard is converted to TSS target based on the correlation between turbidity and TSS for each stream. The following table shows the TSS targets for each stream.

TABLE 6-1: TOTAL SUSPENDED SOLIDS TARGETS

Streams	TSS & Turbidity Correlation	TSS Target (mg/L)
Turkey Creek	TSS = 1.12 × turbidity	56.0
Little Turkey Creek	TSS = 0.67 × turbidity	33.5
Buffalo Creek	TSS = 1.04 × turbidity	52.0
Clear Creek	TSS = 1.85 × turbidity	92.5

6.2 FECAL COLIFORM STANDARDS

Beneficial uses shall be deemed to be fully supported with respect to fecal coliform if the geometric mean of all samples is less than 200 colonies per 100 ml and no more than 10% of the samples exceed 400 colonies per 100 ml (785:46-15-6) [2].

6.3 ANTIDEGRADATION POLICY

Oklahoma antidegradation policy (OAC 785:45-3) requires protecting all waters of the state from degradation of water quality. The targets of this TMDL, resulting load reduction and load allocations in this report were set with regard for all elements of the Oklahoma Water Quality standards which includes the antidegradation policy. With the implementation of this TMDL, the water quality in Turkey Creek Watershed will be improving rather than degrading.

6.4 SEASONAL VARIABILITY

Federal regulations (40 CFR §130.7(c)(1)) require that TMDLs account for seasonal variation in watershed conditions and pollutant loading. Seasonal variation was accounted for in this TMDL study by using more than a year worth monthly quality data and daily flow records monitored by the OCC from October of 2003 to October of 2005. Rainfall data from 1995 to 2005 was also looked at to see if the data are likely to represent the typical climatic conditions.

7. Watershed Modeling and Wasteload Allocations/Reductions

The TMDL calculations presented in this report are derived from load duration curves (LDC). LDCs facilitate rapid development of TMDLs. The technical approach for using LDCs for TMDL development includes the four following steps:

1. Preparing flow duration curves for gaged and ungaged water quality monitoring (WQM) stations;
2. Preparing load duration curves based on flow duration curve and WQS;
3. Estimating existing loading in the receiving water using ambient water quality data; and
4. Identifying loading reduction rate necessary to attain WQS.

Historically it was customary in developing WLAs to designate a critical low flow condition (*e.g.,* 7Q2) at which the maximum permissible loading was calculated for pollutants from point sources. 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 treatment plant effluents would dominate the base flow of the impaired water.

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.

Oklahoma Conservation Commission monitored stream flow at the lower end of Turkey Creek from October 2003 through October 2005. This observed data was used to develop the flow duration curve for Turkey Creek. However, there was no flow data for any tributaries of Turkey Creek. The flow for these tributaries was estimated using a calibrated Hydrologic Simulation Program - FORTRAN (HSPF) model. The observed data on Turkey Creek was used to calibrate the HSPF model.

7.1 HSPF MODEL AND FLOW CALIBRATION

There are numerous models that can continuously simulate stream flow, sediment, and nutrientloading from watersheds. The HSPF and Soil & Water Assessment Tool (SWAT) are the two most widely used watershed models that are supported by the EPA. HSPF is a lumped watershed model that simulates runoff and pollutant loadings from a watershed, integrating these with point source contributions, and performs hydrologic and water quality processes in reaches. SWAT is a physical based, watershed scaled model to predict the effects of land management on water, sediment, and agricultural chemical yields in a complex watershed. The HSPF model was selected in this study to simulate stream flows in Turkey Creek and its tributaries because it was easier to set up the model with The Better Assessment Science Integrating point and Nonpoint Sources (BASINS) software system.

The BASINS software system was used to delineate sub-basins for the Turkey Creek watershed and create input files to the HSFP model. The Digital Elevation Model (DEM) grid data provided with the BASINS 3.0 and The National Hydrography Dataset (NHD) stream network were used in delineating the sub-watershed. The DEM data has 3 arc-second (around 90 × 90 meter) resolution.

Hourly weather data comes from Oklahoma Mesonet. The weather data includes air temperature, air pressure, dew point, relative humidity, wind direction and speed, rainfall, solar radiation, pan evaporation, and evapotranspiration. Eleven-year weather data was obtained to run the HSPF model. The model was calibrated for stream flow using the flow data at the lower Turkey Creek from October of 2003 to October 2005. Table 7-0 and Figure 7-1 shows the variation of annual rainfall amount for the simulation period. It should note that the annual rainfall for 2005 was calculated using data from January to October and then prorated to a full year.

TABLE 7-0: ANNUAL RAINFALL AMOUNT AT LAHO STATION

Year	Rainfall (in)
1995	37.40
1996	28.48
1997	40.75
1998	35.55
1999	43.07
2000	28.01
2001	22.52
2002	29.12
2003	19.70
2004	33.56
2005	31.04
Average	**31.75**

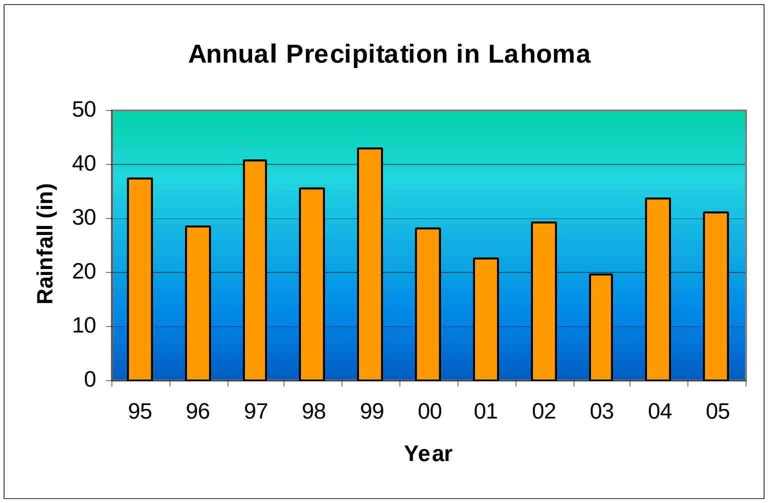


FIGURE 7-1. ANNUAL RAINFALL IN LAHOMA

The Turkey Creek watershed was divided into twenty-three (23) sub-watersheds (Figure 7-2). A Window version of HSPF, WINHSPF v2.3, was used to simulate flows for streams in the Turkey Creek watershed.

Flow calibration scenarios for NPSM/HSPF model posted on EPA's BASINS web site (http://www.epa.gov/waterscience/ftp/basins/training/tutorial/di.htm) were followed in the flow calibration for Turkey Creek. These scenarios provide guidance as for what parameters to adjust in order to achieve satisfactory flow calibrations. For details, please consult the above web site for online tutorial for NPSM/HSPF calibration.

The calibration was mainly based upon model-data comparisons for annual, seasonal water balance, and average monthly flow. Comparisons were also made for daily flow during the calibration to ensure that storm flows (time to peak, peak flow and flow recession) were matched reasonably well.

Table 7-1 and 7-2 show the annual and seasonal water balance.

TABLE 7-1: ANNUAL WATER BALANCE

Year	Observed	Simulated	Difference
2004	9739.78	8899.90	8.6%
2005	17417.90	18758.60	-7.7%
Total	27157.67	27658.50	-1.8%

TABLE 7-2: SEASONAL WATER BALANCE

	Simulated	OBS	Diff		Simulated	OBS	Diff
2004							
December	404.6			June	3457.6		
January	93.9			July	-		
February	1427.7			August	-		
Winter	1926.2	1844.1	-4.4%	**Summer**	3457.6	3472.4	0.4%
2005							
December	-			June	4558.1		
January	-			July	1658.0		
February	-			August	6080.4		
Winter	-	-		**Summer**	12296.5	11885.2	-3.5%
Total	**1926.2**	**1844.1**	**-4.4%**	**Total**	**15754.1**	**15357.6**	**-2.6%**

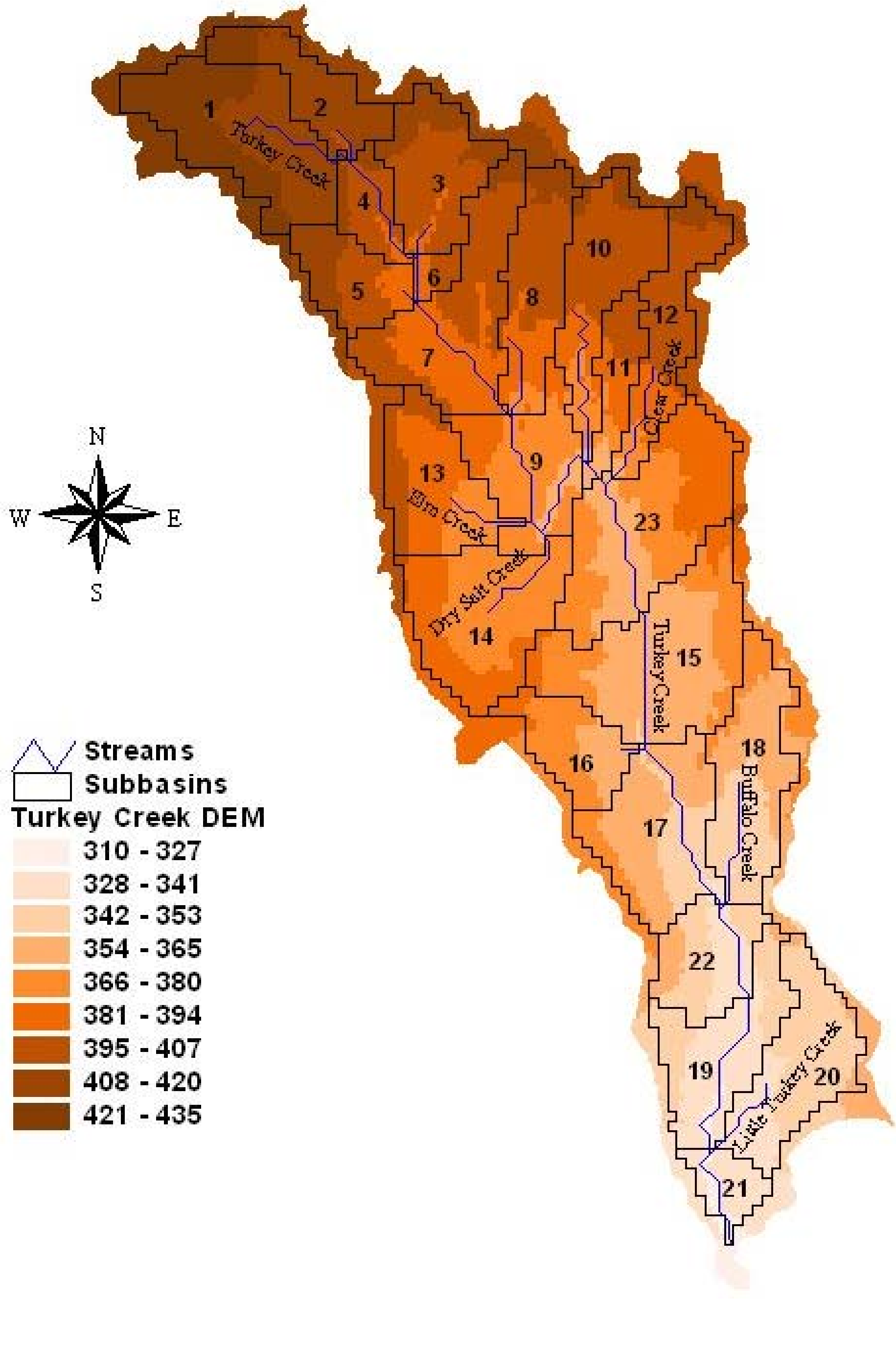


FIGURE 7-2. TURKEY CREEK SUBBASINS

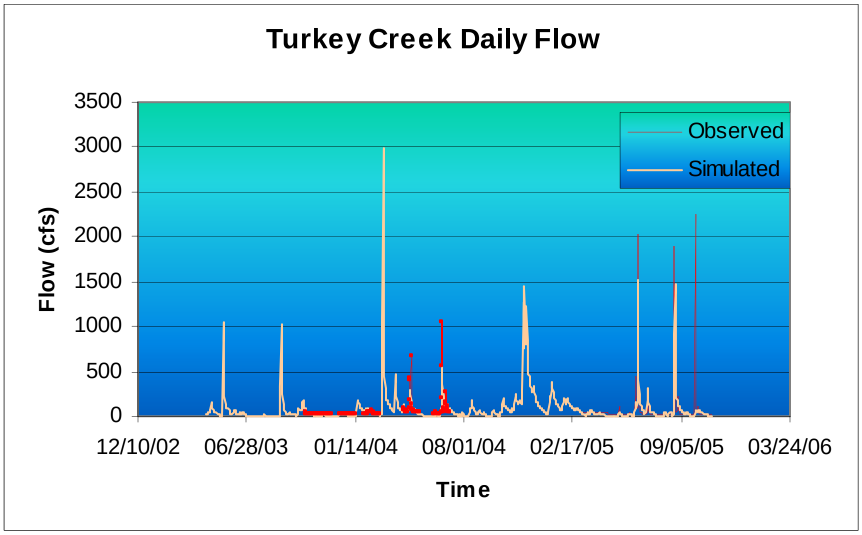


FIGURE 7-3. COMPARISON BETWEEN OBSERVED AND SIMULATED FLOWS (2003-2005)

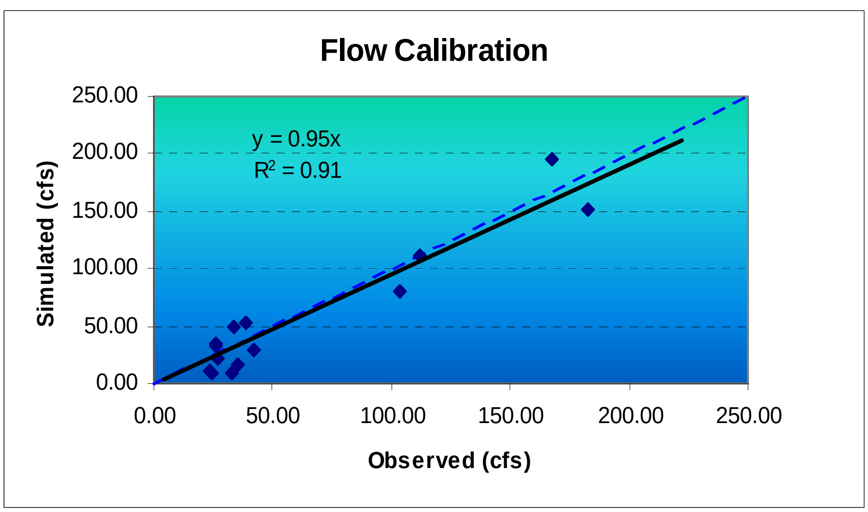


FIGURE 7-4. COMPARISON OF AVERAGE MONTHLY FLOWS

7.2 Margin of Safety

The margin of safety (MOS), designed to account for uncertainty in calculations, is a required element of a TMDL.

Both implicit and explicit margin of safeties were used in the TMDL development depending on pollutants. Explicit margin of safety was used for fecal coliform and implicit margin of safety for TSS.

Two MOSs were selected in fecal coliform TMDL calculations. For Turkey Creek, because the observed stream flows were used to develop the load duration curves, the uncertainty involved in the TMDL calculations lays only in the observed data. Therefore, margin of safety of 10% was selected. For other streams there were added uncertainties introduced by the HSPF model because predicted flows by HSPF were used to develop load duration curves so a margin of safety of 20% was chosen.

An implicit MOS was chosen for TSS TMDL calculations. This is because the TSS targets apply only to base flow condition. The TMDL calculation for TSS in this study includes all flow conditions except the top 25% high flow events. Another conservative assumption that TSS is a conservative parameter and does not settle out in the water column was used to calculate the TMDLs. These conservative assumptions will account for uncertainty in TSS TMDL calculations.

7.3 Load Duration Curves & Reductions

Once the HSPF model was calibrated for stream flow for Turkey Creek, the model was used to predict daily flow for Turkey Creek, Little Turkey Creek, Buffalo Creek and Clear Creek. The predicted flows were used to develop flow duration curve.

Load for fecal coliform and TSS were calculated as follows:

- Load duration curve for Fecal Coliform:

  Fecal Coliform Load = flow × concentration × 24.466×10^{6} (/day)

  Where flow is in cfs and concentration for fecal coliform is in /100ml.

- Load duration curve for TSS:

  TSS Load = 8.34 × (flow × 0.646) × concentration

  Where flow is in cfs and TSS concentration is in mg/L.

A load duration curve is developed when the TMDL target concentration is used in the load calculation. For example, the TDML target for TSS in Turkey Creek is 56 mg/L. The following formula is used to develop load duration curve for TSS in Turkey Creek:

$$\text{TSS load} = 8.34 \times (\text{flow} \times 0.646) \times 56.0$$

This calculation is repeated for all flow conditions and the plot of the resulting TSS loads against corresponding flow exceedence is the load duration curve for TSS in Turkey Creek.

7.3.a Turkey Creek

A flow duration curve was developed using predicted flows from 1997 to 2004. All flow values were sorted in descending order and the chance of exceedance in percent was calculated for each flow. The flow duration curve is shown in Figure 7-5.

The load reduction calculations for bacteria are shown in Table 10-3. The 6th column of the table, "Fecal Coli Load", is the observed load. The 7th column of the table, "Standards" or allowable load, is calculated using the following formula:

$$\text{Load} = \text{flow} \times 400 \times 24.466 \times 10^{6} \times 0.9$$

Where "400" is the TMDL target for fecal coliform and 0.9 accounts for 10% margin of safety.

A comparison is made between Column 6 (current load) and column 7 (load allowed according to standards). If 10% or less of values in column 6 are greater than the corresponding values in column 7, bacteria standards are met and the stream is not impaired with regard to bacteria.

If more than 10% of values in column 6 are greater than the values in column 7, a reduction must be made to the load in column 6. The load after the reduction is presented in columns 8. The reduction rate is to ensure 10% or less of values in column 8 greater than the allowable loads in column 7. The geometric mean of the reduced load also needs to be less than that of the allowable load.

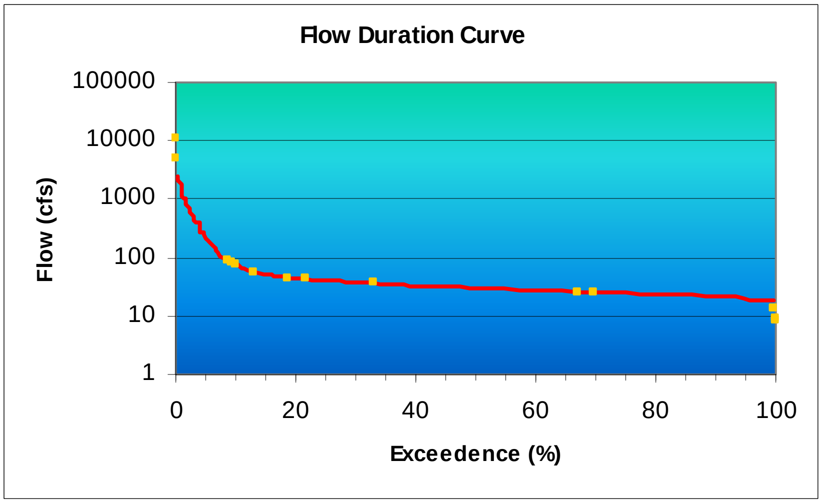


FIGURE 7-5. TURKEY CREEK FLOW DURATION CURVE

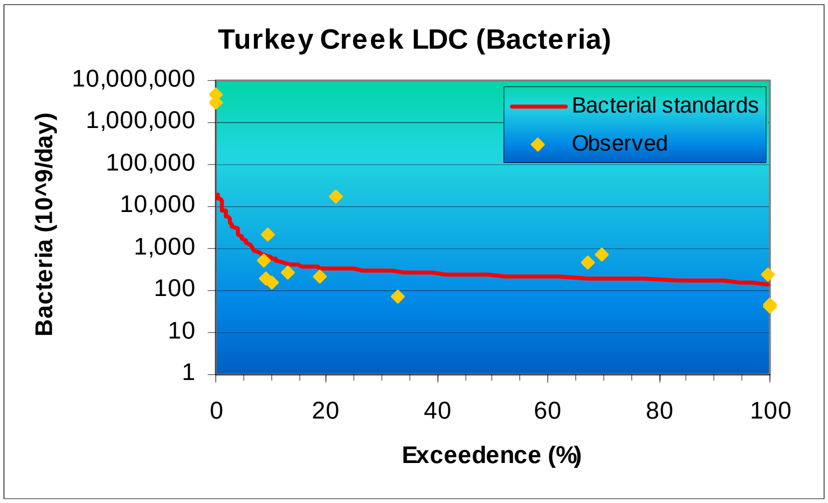


FIGURE 7-6. TURKEY CREEK BACTERIA LOAD DURATION CURVE AND OBSERVED LOAD

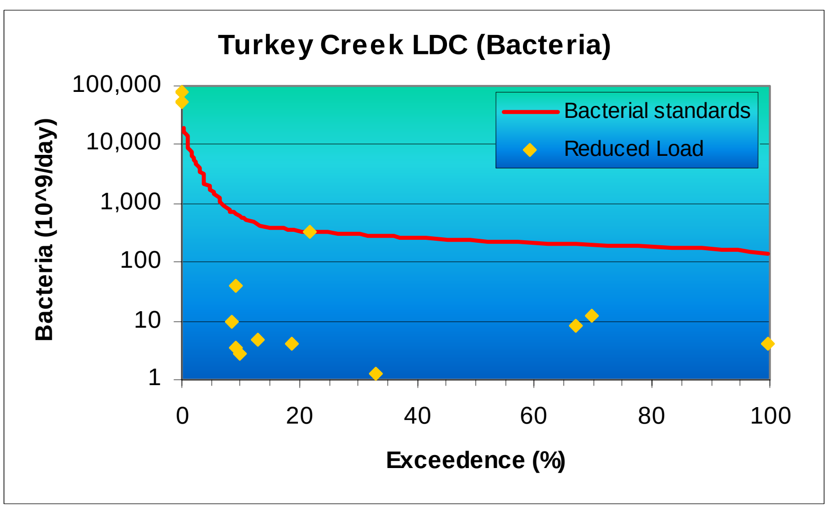


FIGURE 7-7. TURKEY CREEK BACTERIA LOAD DURATION CURVE AND REDUCED LOAD

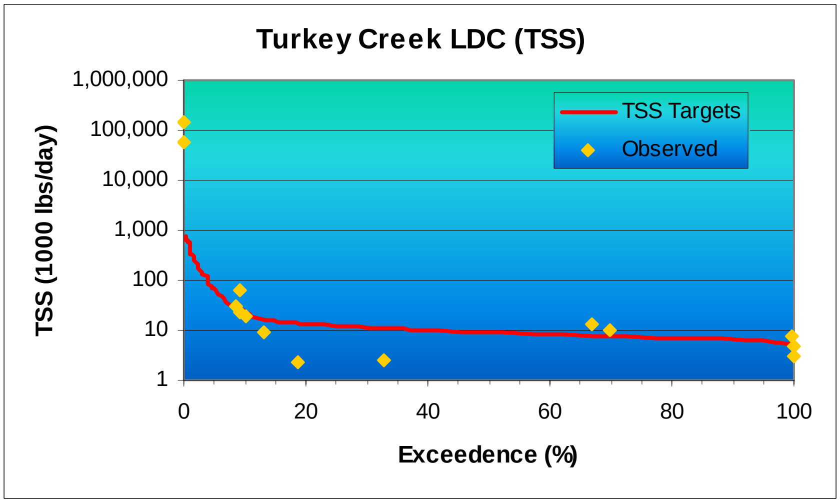


FIGURE 7-8. TURKEY CREEK TSS LOAD DURATION CURVE AND OBSERVED LOAD

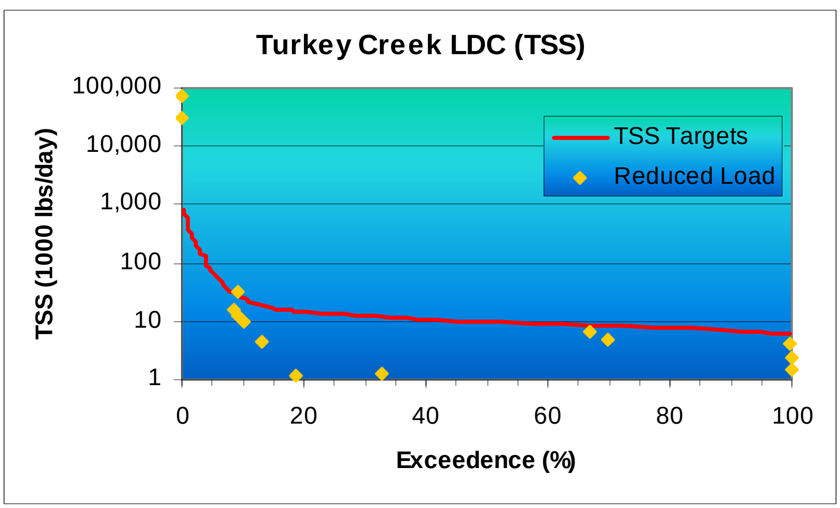


FIGURE 7-9. TURKEY CREEK TSS LOAD DURATION CURVE AND REDUCED LOAD

As shown in Table 10-3, a 97.9% load reduction in fecal coliform is needed for Turkey Creek to meet fecal coliform standards.

Figure 7-6 shows the fecal coliform load duration curve and observed load. Points above the curve violate standards and points below the curve meet standards. Figure 7-7 shows the load duration curve and reduced fecal coliform load.

The load reduction calculations for TSS are presented in Table 10-4. The TSS target is 56 mg/L for Turkey Creek. Similar to load calculations for bacteria, column 6 of the table represents the current TSS load and column 7 represents the TSS load allowed according to the TMDL target. A comparison was also made between columns 6 and 7. After excluding the loads under high flow event (top 25% high flows), if more than 10% values in column 6 are greater than those in column 7, reductions to TSS load must be made. The reduced load is given in column 8.

A 58.6% load reduction in TSS is needed for Turkey Creek to meet turbidity standards.

Figure 8 shows the TSS load duration curve and the current TSS load. Figure 9 shows the load duration curve and the reduced TSS load.

7.3.b Little Turkey Creek

The same calculations for Turkey Creek were repeated for Little Turkey Creek, Buffalo Creek and Clear.

Table 10-5 shows the load calculations for fecal coliform and Table 10-6 shows the calculations for TSS for Little Turkey Creek. The TMDL target for TSS is 33.5 mg/L for Little Turkey Creek.

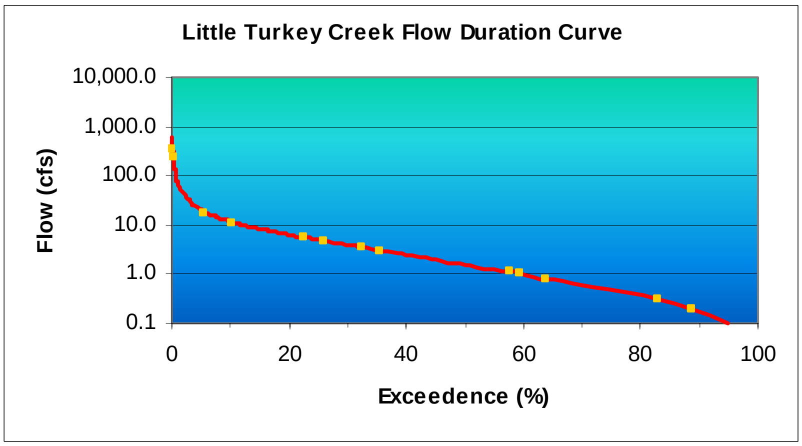


FIGURE 7-9. FLOW DURATION CURVE FOR LITTLE TURKEY CREEK

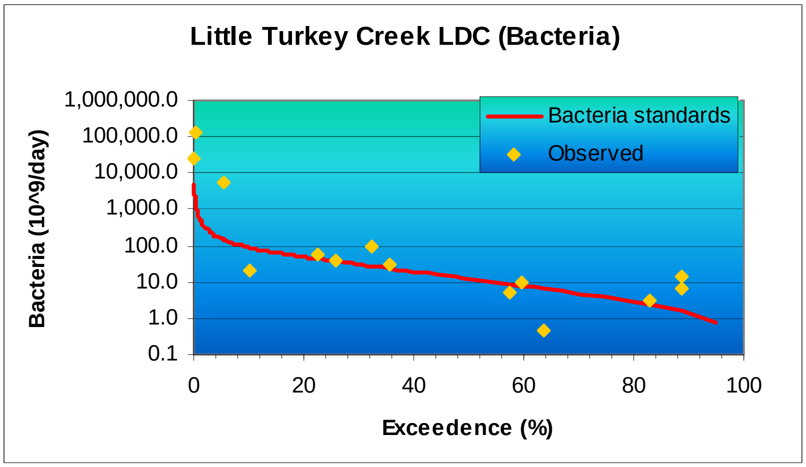


FIGURE 7-10. LITTLE TURKEY CREEK BACTERIA LOAD DURATION CURVE AND OBSERVED LOAD

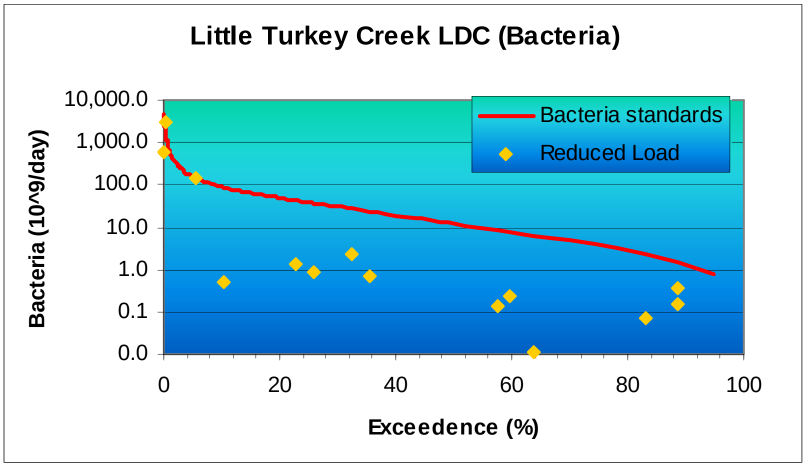


FIGURE 7-11. LITTLE TURKEY CREEK BACTERIA LOAD DURATION CURVE AND REDUCED LOAD

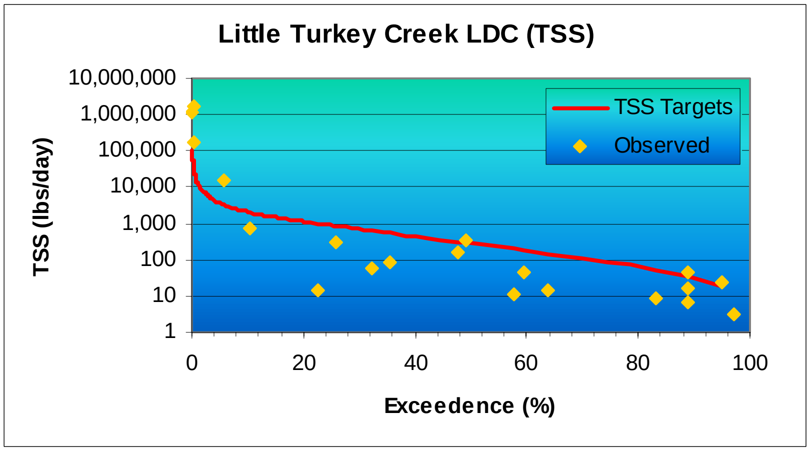


FIGURE 7-12. LITTLE TURKEY CREEK TSS LOAD DURATION CURVE AND OBSERVED LOAD

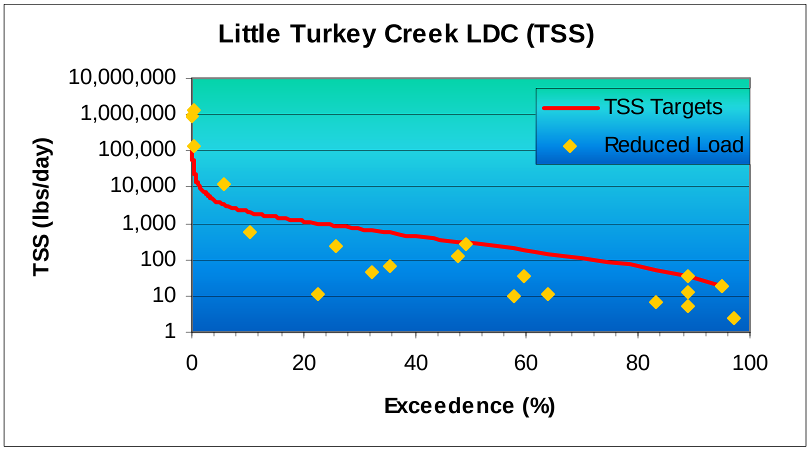


FIGURE 7-13. LITTLE TURKEY CREEK TSS LOAD DURATION CURVE AND REDUCED LOAD

A 97.6% load reduction in fecal coliform is needed and a 37.6% load reduction in TSS is needed for Little Turkey Creek.

Figure 7-9 show the flow duration curve for Little Turkey Creek. Figures 10 and 11 show the load duration curve for fecal coliform together with observed load and reduced load, respectively. Figures 13 and 14 show the load duration curve for TSS and observed and reduced TSS load.

7.3.c Buffalo Creek

Table 10-7 shows the load calculations for fecal coliform and Table 10-8 shows the calculations for TSS for Buffalo Creek. The TMDL target for TSS is 52 mg/L for Buffalo Creek.

A 96% load reduction in fecal coliform is needed and a 60.5% load reduction in TSS is needed for Buffalo Creek.

Figure 7-14 show the flow duration curve for Buffalo Creek. Figures 15 and 16 show the load duration curve for fecal coliform together with observed load and reduced load, respectively. Figures 17 and 18 show the load duration curve for TSS and observed and reduced TSS load.

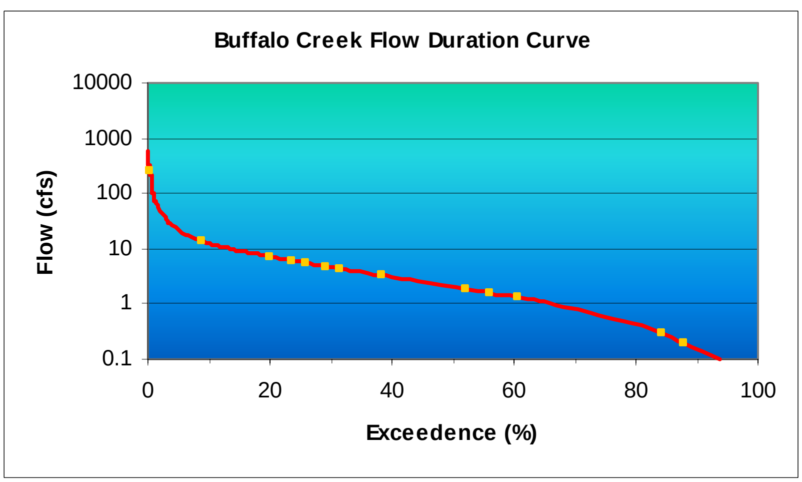


FIGURE 7-14. FLOW DURATION CURVE FOR BUFFALO CREEK

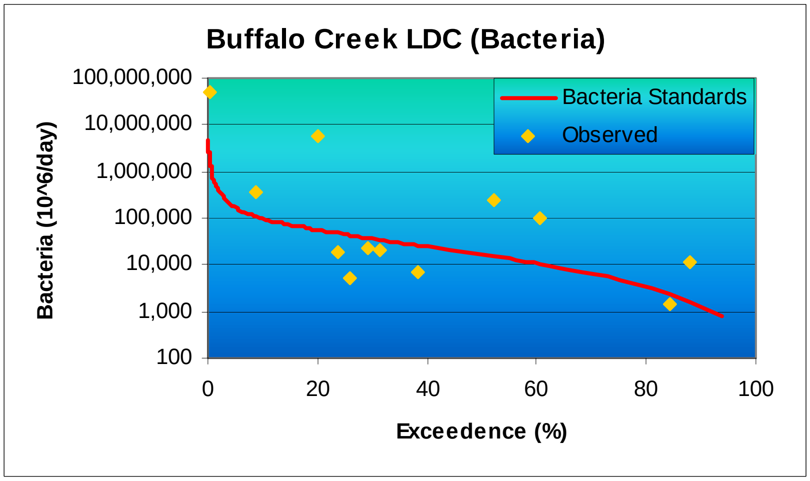


FIGURE 7-15. BUFFALO CREEK BACTERIA LOAD DURATION CURVE AND OBSERVED LOAD

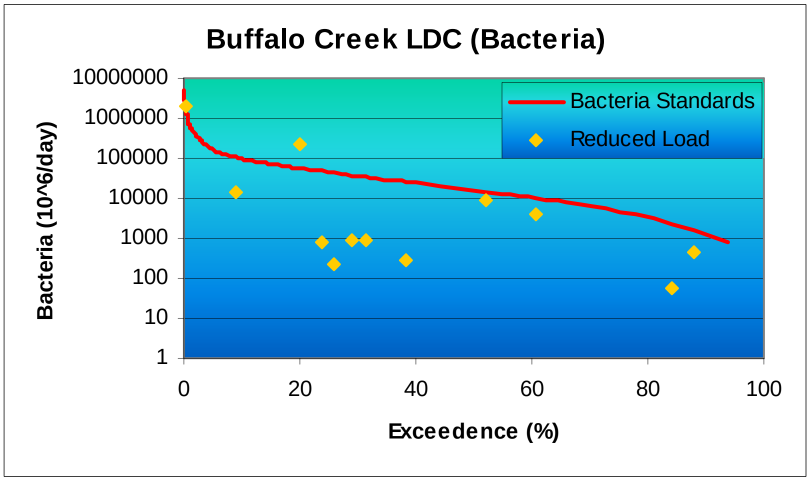


FIGURE 7-16. BUFFALO CREEK BACTERIA LOAD DURATION CURVE AND REDUCED LOAD

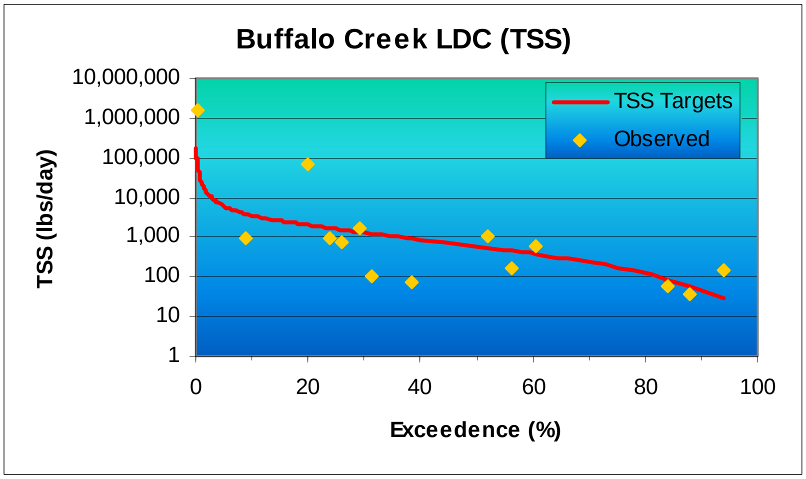


FIGURE 7-17. BUFFALO CREEK TSS LOAD DURATION CURVE AND OBSERVED LOAD

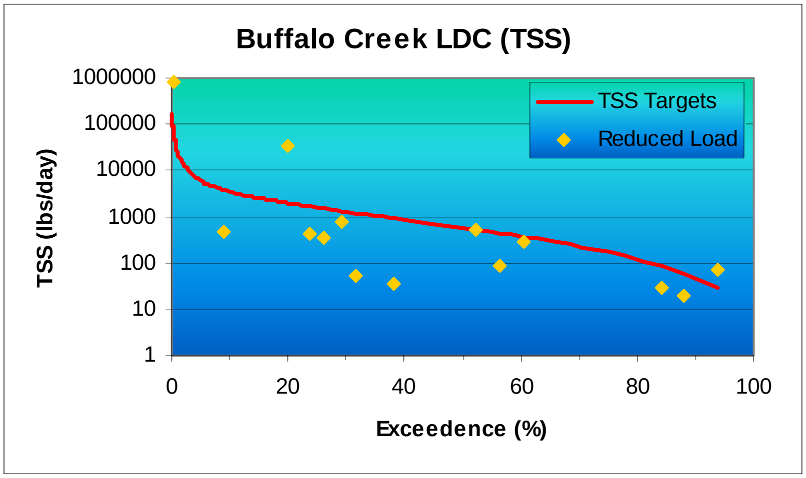


FIGURE 7-18. BUFFALO CREEK TSS LOAD DURATION CURVE AND REDUCED LOAD

7.3.d Clear Creek

Table 10-9 shows the load calculations for fecal coliform and Table 10-10 shows the calculations for TSS for Clear Creek. The TMDL target for TSS is 92.5 mg/L for Clear Creek.

A 97.6% load reduction in fecal coliform is needed. After excluding the loads under high flow events, all current TSS loads are less than the allowable loads. No TSS reduction is needed for Clear Creek.

Figure 7-19 show the flow duration curve for Clear Creek. Figures 20 and 21 show the load duration curve for fecal coliform together with observed load and reduced load, respectively. Figure 22 shows the load duration curve for TSS and observed TSS load.

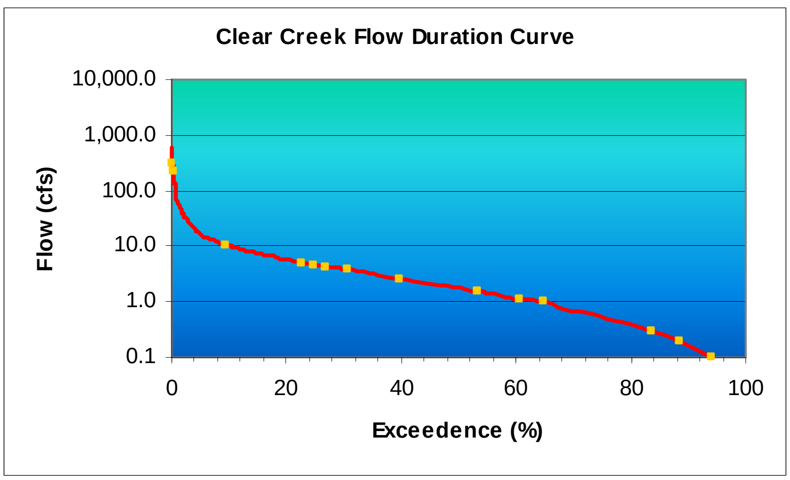


FIGURE 7-19 FLOW DURATION CURVE FOR CLEAR CREEK

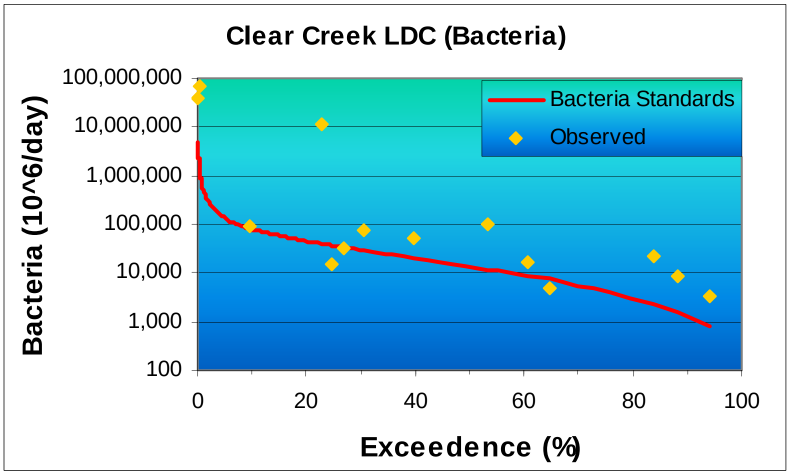


FIGURE 7-20. CLEAR CREEK BACTERIA LOAD DURATION CURVE AND OBSERVED LOAD

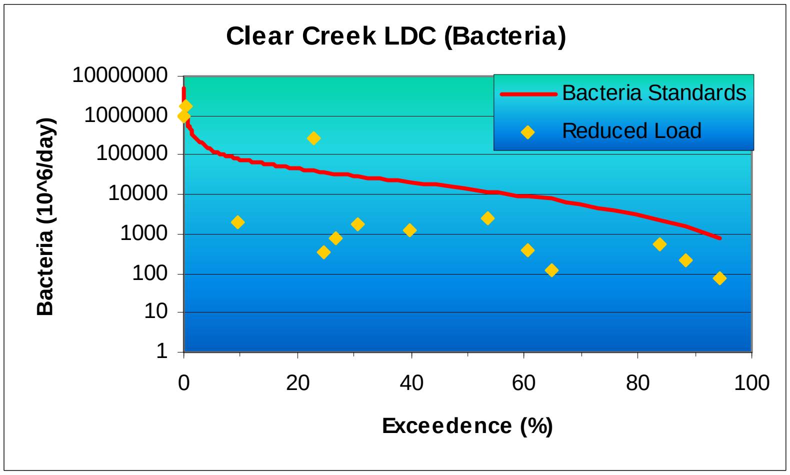


FIGURE 7-21. CLEAR CREEK BACTERIA LOAD DURATION CURVE AND REDUCED LOAD

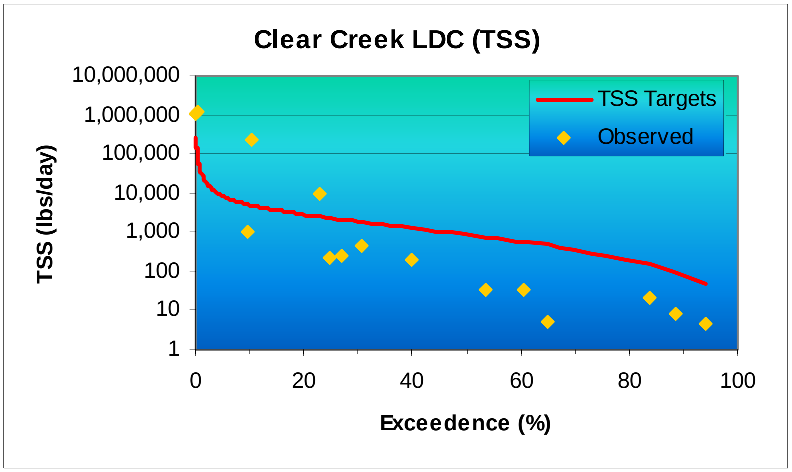


FIGURE 7-22. CLEAR CREEK TSS LOAD DURATION CURVE AND OBSERVED LOAD

7.3.e Summary of reductions

The following table summarizes the reduction rate for each stream:

TABLE 7-1: SUMMARY OF TMDL REDUCTION GOAL

Stream Names	Fecal Coliform Reduction	TSS Reduction
Turkey Creek	98.2%	48.3%
Little Turkey Creek	97.6%	22.0%
Buffalo Creek	96.0%	50.5%
Clear Creek	97.6%	0%

7.4 TMDL CALCULATIONS

Total Maximum Daily Load can be expressed as follows:

TMDL = LA + WLA + MOS

Where

LA – allocations for nonpoint sources
WLA – allocations for point sources
MOS – margin of safety, which can be implicit or explicit

The maximum assimilative capacity of a stream depends on the flow conditions of the stream. The higher the flow is, the more wasteload the stream can handle without violating water quality standards. Therefore, a flow condition has to be set before we can calculate the TMDL. It is decided in this study that we will calculate the TMDL at flow with 5%, 10% … 95% flow exceedance frequency (5% increment).

7.4.a Total Suspended Solids/Turbidity

The WLAs from point sources were set to zero because the surrogate being used for turbidity (TSS) is considered to represent inorganic suspended solids (i.e., soil and sediment particles from erosion or sediment resuspension). The suspended solids discharged by point sources in the Turkey Creek watershed are assumed to consist primarily of organic solids rather than inorganic solids. Discharges of organic suspended solids from point sources are already addressed by ODEQ through their permitting of point sources to maintain water quality standards for dissolved oxygen. The WLAs to support these TMDLs will not require any changes to the permits concerning inorganic suspended solids. Therefore, future growth for these permits or new permits would not be restricted by these turbidity TMDLs.

Implicit margin of safety was used in the study. Therefore, no specific numbers were assigned to MOS in the TMDL calculations. Table 7-2 through 7-5 shows the TMDL calculations for Turkey Creek, Little Turkey Creek, Buffalo Creek and Clear Creek respectively. Since turbidity standard only apply to base flow condition, LA for flow exceedance of 20% or less are not calculated.

To accommodate potential growth in the watershed, 1% of TSS loading is reserved for storm water permits for constructions. The conditions in storm water permits will be sufficient to protect waters in the watershed.

Table 7-2: TSS WLA/LA for Turkey Creek

Flow Exceedance (%)	Flow (cfs)	TMDL (lbs/day)	WLA (lbs/day)	LA (lbs/day)	MOS	Reserved Capacity (lbs/day)
5	197.17	N/A	0.0	N/A	N/A	N/A
10	73.72	N/A	0.0	N/A	N/A	N/A
15	50.63	N/A	0.0	N/A	N/A	N/A
20	43.31	N/A	0.0	N/A	N/A	N/A
25	40.67	12271.0	0.0	12148.3	Implicit	122.7
30	38.07	11486.5	0.0	11371.6	Implicit	114.9
35	35.53	10719.1	0.0	10611.9	Implicit	107.2
40	32.17	9705.9	0.0	9608.8	Implicit	97.1
45	31.18	9406.0	0.0	9311.9	Implicit	94.1
50	29.73	8970.2	0.0	8880.5	Implicit	89.7
55	28.44	8581.8	0.0	8496.0	Implicit	85.8
60	27.48	8290.3	0.0	8207.4	Implicit	82.9
65	26.46	7984.0	0.0	7904.1	Implicit	79.8
70	25.39	7658.9	0.0	7582.3	Implicit	76.6
75	24.31	7334.8	0.0	7261.5	Implicit	73.3
80	23.46	7077.8	0.0	7007.0	Implicit	70.8
85	22.85	6893.4	0.0	6824.5	Implicit	68.9
90	21.66	6535.8	0.0	6470.4	Implicit	65.4
95	19.90	6003.1	0.0	5943.1	Implicit	60.0

TABLE 7-3: TSS WLA/LA FOR LITTLE TURKEY CREEK

Flow Exceedance (%)	Flow (cfs)	TMDL (lbs/day)	WLA (lbs/day)	LA (lbs/day)	MOS	Reserved Capacity (lbs/day)
5	19.68	N/A	0.0	N/A	N/A	N/A
10	11.30	N/A	0.0	N/A	N/A	N/A
15	8.10	N/A	0.0	N/A	N/A	N/A
20	6.26	N/A	0.0	N/A	N/A	N/A
25	4.90	884.4	0.0	875.5	Implicit	8.8
30	3.90	703.9	0.0	696.9	Implicit	7.0
35	3.00	541.5	0.0	536.0	Implicit	5.4
40	2.40	433.2	0.0	428.8	Implicit	4.3
45	1.90	342.9	0.0	339.5	Implicit	3.4
50	1.50	270.7	0.0	268.0	Implicit	2.7
55	1.20	216.6	0.0	214.4	Implicit	2.2
60	0.90	162.4	0.0	160.8	Implicit	1.6
65	0.70	126.3	0.0	125.1	Implicit	1.3
70	0.60	108.3	0.0	107.2	Implicit	1.1
75	0.40	72.2	0.0	71.5	Implicit	0.7
80	0.30	54.1	0.0	53.6	Implicit	0.5
85	0.20	36.1	0.0	35.7	Implicit	0.4
90	0.10	18.0	0.0	17.9	Implicit	0.2
95	0.00	0.0	0.0	0.0	Implicit	0.0

Table 7-4: TSS WLA/LA for Buffalo Creek

Flow Exceedance (%)	Flow (cfs)	TMDL (lbs/day)	WLA (lbs/day)	LA (lbs/day)	MOS	Reserved Capacity (lbs/day)
5	21.24	N/A	0.0	N/A	N/A	N/A
10	12.40	N/A	0.0	N/A	N/A	N/A
15	9.14	N/A	0.0	N/A	N/A	N/A
20	7.00	N/A	0.0	N/A	N/A	N/A
25	5.70	1596.9	0.0	1580.9	Implicit	16.0
30	4.50	1260.7	0.0	1248.1	Implicit	12.6
35	3.70	1036.6	0.0	1026.2	Implicit	10.4
40	3.04	851.7	0.0	843.2	Implicit	8.5
45	2.50	700.4	0.0	693.4	Implicit	7.0
50	2.00	560.3	0.0	554.7	Implicit	5.6
55	1.60	448.3	0.0	443.8	Implicit	4.5
60	1.30	364.2	0.0	360.6	Implicit	3.6
65	1.00	280.2	0.0	277.4	Implicit	2.8
70	0.80	224.1	0.0	221.9	Implicit	2.2
75	0.60	168.1	0.0	166.4	Implicit	1.7
80	0.40	112.1	0.0	110.9	Implicit	1.1
85	0.20	56.0	0.0	55.5	Implicit	0.6
90	0.10	28.0	0.0	27.7	Implicit	0.3
95	0.00	0.0	0.0	0.0	Implicit	0.0

Table 7-5: TSS WLA/LA for Clear Creek

Flow Exceedance (%)	Flow (cfs)	TMDL (lbs/day)	WLA (lbs/day)	LA (lbs/day)	MOS	Reserved Capacity (lbs/day)
5	16.84	N/A	0.0	N/A	N/A	N/A
10	9.90	N/A	0.0	N/A	N/A	N/A
15	7.34	N/A	0.0	N/A	N/A	N/A
20	5.60	N/A	0.0	N/A	N/A	N/A
25	4.60	2292.4	0.0	2269.5	Implicit	22.9
30	3.70	1843.9	0.0	1825.5	Implicit	18.4
35	3.06	1525.0	0.0	1509.7	Implicit	15.2
40	2.50	1245.9	0.0	1233.4	Implicit	12.5
45	2.10	1046.5	0.0	1036.1	Implicit	10.5
50	1.70	847.2	0.0	838.7	Implicit	8.5
55	1.40	697.7	0.0	690.7	Implicit	7.0
60	1.10	548.2	0.0	542.7	Implicit	5.5
65	0.80	398.7	0.0	394.7	Implicit	4.0
70	0.60	299.0	0.0	296.0	Implicit	3.0
75	0.50	249.2	0.0	246.7	Implicit	2.5
80	0.30	149.5	0.0	148.0	Implicit	1.5
85	0.20	99.7	0.0	98.7	Implicit	1.0
90	0.10	49.8	0.0	49.3	Implicit	0.5
95	0.00	0.0	0.0	0.0	Implicit	0.0

7.4.b Fecal Coliform

The three minor wastewater treatment facilities are lagoon system and do not have fecal coliform limits because fecal coliform limits are not required currently in Oklahoma municipal discharge permit for lagoon systems. However, because the receiving streams of the above facilities are impaired with regard to pathogens, the following fecal coliform limits will be recommended for those facilities:

Monthly average: 200 /100ml; Sample Maximum: 400 /100ml

The fecal coliform wasteload allocations for Turkey Creek was calculated based on the above limits and discharge flows from the three minor wastewater treatment facilities. The WLA for Little Turkey Creek, Buffalo Creek and Clear Creek was zero because there was no point discharge to these streams.

The margin of safety of 10% was used for Turkey Creek and the margin of safety of 20% was used for Little Turkey Creek, Buffalo Creek and Clear Creek.

No fecal coliform loading was reserved construction storm water permit because construction site is not considered as a source for bacteria, but TSS.

TABLE 7-6: FECAL COLIFORM WLA/LA FOR TURKEY CREEK

Flow Exceedance (%)	Flow (cfs)	TMDL (10^6 /day)	WLA (10^6 /day)	LA (10^6 /day)	MOS (10^6 /day)
5	197.17	1,929,538	3,674	1,732,910	192,954
10	73.72	721,416	3,674	645,601	72,142
15	50.63	495,434	3,674	442,217	49,543
20	43.31	423,873	3,674	377,812	42,387
25	40.67	398,026	3,674	354,550	39,803
30	38.07	372,579	3,674	331,648	37,258
35	35.53	347,688	3,674	309,246	34,769
40	32.17	314,824	3,674	279,668	31,482
45	31.18	305,096	3,674	270,913	30,510
50	29.73	290,960	3,674	258,190	29,096
55	28.44	278,363	3,674	246,853	27,836
60	27.48	268,907	3,674	238,343	26,891
65	26.46	258,970	3,674	229,399	25,897
70	25.39	248,427	3,674	219,911	24,843
75	24.31	237,914	3,674	210,449	23,791
80	23.46	229,578	3,674	202,946	22,958
85	22.85	223,596	3,674	197,563	22,360
90	21.66	211,997	3,674	187,124	21,200
95	19.90	194,718	3,674	171,572	19,472

TABLE 7-7: FECAL COLIFORM WLA/LA FOR LITTLE TURKEY CREEK

Flow Exceedance (%)	Flow (cfs)	TMDL (10^6/day)	WLA (10^6/day)	LA (10^6/day)	MOS (10^6/day)
5	19.68	192,594	0	154,075	38,519
10	11.30	110,585	0	88,468	22,117
15	8.10	79,269	0	63,415	15,854
20	6.26	61,262	0	49,010	12,252
25	4.90	47,953	0	38,362	9,591
30	3.90	38,166	0	30,533	7,633
35	3.00	29,359	0	23,487	5,872
40	2.40	23,487	0	18,790	4,697
45	1.90	18,594	0	14,875	3,719
50	1.50	14,679	0	11,744	2,936
55	1.20	11,744	0	9,395	2,349
60	0.90	8,808	0	7,046	1,762
65	0.70	6,850	0	5,480	1,370
70	0.60	5,872	0	4,697	1,174
75	0.40	3,915	0	3,132	783
80	0.30	2,936	0	2,349	587
85	0.20	1,957	0	1,566	391
90	0.10	979	0	783	196
95	0.00	0	0	0	0

TABLE 7-8: FECAL COLIFORM WLA/LA FOR BUFFALO CREEK

Flow Exceedance (%)	Flow (cfs)	TMDL (10^6/day)	WLA (10^6/day)	LA (10^6/day)	MOS (10^6/day)
5	21.24	207,861	0	166,288	41,572
10	12.40	121,350	0	97,080	24,270
15	9.14	89,447	0	71,557	17,889
20	7.00	68,504	0	54,803	13,701
25	5.70	55,782	0	44,625	11,156
30	4.50	44,038	0	35,231	8,808
35	3.70	36,209	0	28,967	7,242
40	3.04	29,750	0	23,800	5,950
45	2.50	24,466	0	19,573	4,893
50	2.00	19,573	0	15,658	3,915
55	1.60	15,658	0	12,526	3,132
60	1.30	12,722	0	10,178	2,544
65	1.00	9,786	0	7,829	1,957
70	0.80	7,829	0	6,263	1,566
75	0.60	5,872	0	4,697	1,174
80	0.40	3,915	0	3,132	783
85	0.20	1,957	0	1,566	391
90	0.10	979	0	783	196
95	0.00	0	0	0	0

TABLE 7-9: FECAL COLIFORM WLA/LA FOR CLEAR CREEK

Flow Exceedance (%)	Flow (cfs)	TMDL (10^6/day)	WLA (10^6/day)	LA (10^6/day)	MOS (10^6/day)
5	16.84	164,801	0	131,841	32,960
10	9.90	96,884	0	77,507	19,377
15	7.34	71,831	0	57,465	14,366
20	5.60	54,803	0	43,843	10,961
25	4.60	45,017	0	36,014	9,003
30	3.70	36,209	0	28,967	7,242
35	3.06	29,946	0	23,957	5,989
40	2.50	24,466	0	19,573	4,893
45	2.10	20,551	0	16,441	4,110
50	1.70	16,637	0	13,309	3,327
55	1.40	13,701	0	10,961	2,740
60	1.10	10,765	0	8,612	2,153
65	0.80	7,829	0	6,263	1,566
70	0.60	5,872	0	4,697	1,174
75	0.50	4,893	0	3,915	979
80	0.30	2,936	0	2,349	587
85	0.20	1,957	0	1,566	391
90	0.10	979	0	783	196
95	0.00	0	0	0	0

7.5 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 the implementation of pollution controls and management measures. Various water quality management programs and funding sources provide 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 2002a). The CPP can be viewed from ODEQ's website at http://www.deq.state.ok.us/WQDnew/pubs/. Table 7-10 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 7-10: PARTIAL LIST OF OKLAHOMA WATER QUALITY MANAGEMENT AGENCIES

Agency	Web Link
Oklahoma Conservation Commission	http://www.okcc.state.ok.us/WQ/WQ_home.htm
Oklahoma Department of Wildlife Conservation	http://www.wildlifedepartment.com/watchabl.htm
Oklahoma Department of Agriculture, Food, and Forestry	http://www.oda.state.ok.us/water-home.htm
Oklahoma Water Resources Board	http://www.owrb.state.ok.us/quality/index.php

Nonpoint source pollution is addressed by the Oklahoma Conservation Commission. The primary mechanisms used for management of nonpoint source pollution are incentive-based programs that support the installation of BMPs and public education and outreach. Other programs include regulations and permits for CAFOs. The CAFO Act, as administered by the AEMS, provides CAFO operators the necessary tools and information to deal with the manure and the wastewater that animals produce so streams, lakes, ponds, and ground water 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 Title 252, Chapter 606 of the Oklahoma Pollution 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.
ODEQ also plays a key role in advancing public education about the protection and use of water resources statewide. ODEQ promotes a diligent outreach program to cities and towns, county commissioners, the regulated community, schools, businesses, and Oklahomans who seek information on how to protect, restore, and utilize the State's water resources.

The reduction rates called for in this TMDL report are as high as 98%. The DEQ 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, Kansas DEQ has proposed to exclude certain high flow conditions during which pathogen standards will not apply, although that exclusion was not approved by the EPA. Additionally, EPA 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 Water Quality Standards should be considered. There are three basic approaches to such revisions that may apply.

- Removing the Primary Body Contact Recreation use: This revision would require documentation in a Use Attainability Analysis that the use is not existing and cannot be attained. It is unlikely that this approach would be successful since there is evidence that people do swim in this segment of the river, thus constituting an existing use. Existing uses cannot be removed.
- Modifying application of the existing criteria: This approach would include considerations such as an exemption under certain high flow conditions, an allowance for wildlife or "natural conditions", a sub-category of the use or other special provision for urban areas, or other special provisions for storm flows. Since large bacteria violations occur over all flow ranges, it is likely that large reductions would still be necessary. However, this approach may have merit and should be considered.
- Revising the existing numeric criteria: Oklahoma's current pathogen criteria are based on EPA 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 EPA studies that could result in revisions to their recommendations are on-going. 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 methodology such as that found in EPA guidance.

Unless or until the water quality standards are revised and approved by EPA, Federal rules require that this TMDL must be based on attainment of the current standards. If revisions to the pathogen standards are approved in the future, the reductions specified in this TMDL will be re-evaluated.

8. PUBLIC PARTICIPATION

Federal regulations require EPA to notify the public and seek comment concerning TMDLs that they prepare. These TMDLs were developed under contract to ODEQ, and EPA has held a public review period seeking comments, information and data from the public and any other interested parties. The notice for the public review period was published in the Federal Register on August 11, 2006, and the review period closed on September 11, 2006.

Written comments were received during the public notice period from the Oklahoma Conservation Commission, Oklahoma Farm Bureau, and Tinker Air Force Base. The comments and response will be included in a separate report, which will include comments on similar TMDLs with the same public review period. The final TMDLs will be incorporated in Oklahoma's Water Quality Management Plan.

9. REFERENCES

1. *Title 785, Oklahoma Administrative Code, Chapter 45 Oklahoma's Water Quality Standards,* State Of Oklahoma, 2000.

2. *Title 785, Oklahoma Administrative Code, Chapter 46 Implementation of Oklahoma's Water Quality Standards,* State Of Oklahoma, 2000.

3. *2002 Integrated Water Quality Assessment Report,* Department of Environment Quality, State of Oklahoma, 2003.

4. *Soil Nitrate Survey of Wheat Fields in Garfield County – Turkey Creek Watershed,* Oklahoma Cooperative Extension Service, Oklahoma State University.

5. *Turkey Creek Watershed Demonstration Project, Quality Assurance Project Plan, FY 1996 CWA Section 319 (h) Task 700,* Oklahoma Conservation Commission, State Of Oklahoma, 1997.

6. *Cimarron River Basin in Oklahoma and Kansas, Section 905(b) (WRDA 86) Analysis,* U.S. Army Corps of Engineers, 2000.

10. APPENDIX A

TABLE 10-1: TURBIDITY FOR TURKEY CREEK

Date	Turbidity (NTU)		
	Upper Turkey Creek	Middle Turkey Creek	Lower Turkey Creek
11/4/1997	8.85	5.95	9.45
12/2/1997			5.8
1/13/1998	16.1	36.6	59.5
2/10/1998	15.3	23.9	35.4
3/3/1998	4.42	7.42	6.44
3/16/1998	882		
3/17/1998		854	868
4/14/1998	27.6	29.3	37.2
5/19/1998	10.3	73.5	115
6/16/1998	46.2	16.5	68
7/8/1998	192	1666	
7/16/1998	69.2		
7/22/1998	35.8	4.42	44.5
7/28/1998	16.9	3.34	33.9
7/30/1998		7.98	30.2
8/10/1998			33.2
8/12/1998	36.4	5.48	
8/18/1998	174	18.5	78.9
8/26/1998	41.7	10.4	53
9/22/1998	960		1050
9/29/1998	89.5	41.4	135
10/26/1998	72	54	83.8
11/1/1998			1722
7/27/1999			17
7/28/1999	29.6	9.79	

TABLE 10-2: TURBIDITY & FLOW FOR LITTLE TURKEY CREEK, BUFFALO CREEK AND CLEAR CREEK

Date	Little Turkey Creek				Buffalo Creek			Clear Creek		
	Turbidity (NTU)	Average (NTU)	Flow (cfs)	% Exceed	Turbidity (NTU)	Flow* (cfs)	% Exceed	Turbidity (NTU)	Flow* (cfs)	% Exceed
11/04/97					3.68	3.3	38.28	5.78	2.6	39.86
12/02/97	1.3	1.3	5.5	22.63	4.32	4.3	31.49			
01/13/98	12.6	12.6	11.1	10.32	13.2	13.7	8.83	18.7	10.5	9.49
02/10/98	9.54	9.54	4.7	25.79	22.4	6.1	23.74	6.86	4.7	24.74
03/03/98	2.72	2.72	0.4	78.43	10.7	0.6	75.20	3.88	0.5	75.82
03/16/98	768	768	239	0.28	972	255.0	0.31	665	215.0	0.34
04/14/98	2.94	2.94	3.5	32.42	20.1	5.5	25.98	6.08	4.3	26.84
05/19/98	5.06	5.06	3.0	35.49	53.6	4.8	29.05	10.2	3.7	30.50
06/16/98	4.96	4.96	0.3	83.04	35.5	0.3	84.16	8.59	0.3	83.79
07/08/98								180	5.1	22.72
07/17/98	9.73	9.73	0.4	78.43	15.6	0.6	75.20	9.34	0.5	75.82
07/22/98	2.77	2.77	0.2	88.72	20.8	0.2	87.88	3.05	0.2	88.38
07/28/98	3.25	3.25	0.6		60.7	0.5	77.96	7.81	0.5	75.82
08/05/98	2.12	2.12	0.2	88.72						
08/11/98								6.91	0.6	72.97
08/12/98	3.63	3.63	0.8	63.70	40.8	0.5	77.96			
08/18/98	6.55	6.55	0.2	88.72	153	0.1	93.86	5.69	0.1	94.23
08/26/98	6.19	6.19	0.3	88.04	91.4	0.1	93.86	6.16	0.2	88.38
09/22/98	161	161	18	5.61	3415	7.1	19.90	3540	9.8	10.35
09/29/98	7.19	7.19	0.8	63.70	222	1.3	60.60	2.75	1	64.79
10/26/98	2.81	2.81	1.1	57.56	186	1.9	52.08	2.87	1.5	53.35
11/01/98	490	490	347	0.12				507	311.0	0.12
07/27/99	3.88	3.88	1.0	59.55	14.6	1.6	56.20			
07/28/99								4.95	1.1	60.66
04/10/01	2.23	45.215	0.4	78.43						
04/10/01	88.2									
05/15/01	8.12	38.86	0.7	66.80						
05/15/01	69.6									
05/18/01	53.1	139.55	178	0.37						
05/18/01	226									
06/11/01	44.4	58.1	2.1	43.46						
06/11/01	71.8									
07/12/01	28.5	28.5	0.2	88.72						
09/25/01	20.2	90.6	1.6	49.01						
09/25/01	161									
11/13/01	40.4	40.4	0.1	94.85						
12/27/01	15.4	15.4	0.05	97.00						
02/04/02	14.7	20.1	1.7	47.64						
02/04/02	25.5									
03/20/02	16.6	63.8	0.1	94.85						
03/20/02	111									
04/16/02	26.8	68.9	0.3	83.04						
04/16/02	111									

* Flow was predicted by the HSPF model

TABLE 10-3: TURKEY CREEK FECAL COLIFORM LOAD REDUCTION CALCULATIONS

Date	Fecal Coli. (/100ml)	Geo-Mean (/100ml)	Flow (cfs)	Flow Frequency (%)	Fecal Coli Load (10^9/day)	Standards (10^9/day)	97.9% Load Reduction (10^9/day)
11/04/97	80	80	36.51	32.9	71.5	321.6	1.5
12/02/97	200	200	45.21	18.8	221.2	398.2	4.6
01/13/98	230	230	92.88	8.5	522.6	818.0	11.0
02/10/98	80	80	76.95	10	150.6	677.7	3.2
03/17/98	24000	24000	5150	0.1	**3023874.0**	45358.1	**63501.4**
04/14/98	90	90	85.18	9.2	187.6	750.2	3.9
05/19/98	1100	1100	84.11	9.3	**2263.5**	740.8	47.5
06/16/98	5000	737	26.28	67	**473.7**	231.5	9.9
06/16/98	400						
06/16/98	200						
07/22/98	200	200	9.41	99.9	46.0	82.9	1.0
08/18/98	200	200	8.61	99.9	42.1	75.8	0.9
09/22/98	17000	17000	42.5	21.6	**17676.0**	374.3	371.2
09/29/98	1300	721	13.33	99.8	**235.2**	117.4	4.9
09/29/98	400						
10/26/98	1100	1100	25.5	69.8	**686.2**	224.6	14.4
11/01/98	17000	17000	10900	0.05	**4533364.5**	96000.7	95200.7
07/27/99	200	200	56.37	13	275.8	496.5	5.8
				GeoMean	**1116.7**	319.8	**23.5**

TABLE 10-4: TURKEY CREEK TSS LOAD REDUCTION CALCULATIONS

Date	TSS (mg/L)	TSS Mean (mg/L)	Flow (cfs)	Flow Exceed (%)	TSS Load (lbs/day)	Targets (lbs/day)	48.3% TSS Reduction (lbs/day)
11/04/97	12.5	13	36.51	32.9	2.5	11.0	1.3
12/02/97	9.5	10	45.21	18.8	2.3	13.7	1.2
01/13/98	59	59	92.88	8.5	**29.5**	28.1	15.3
02/10/98	45.5	46	76.95	10	18.9	23.2	9.8
03/17/98	2145	2145	5150	0.05	**59515.9**	1555.7	**30769.7**
04/14/98	52	52	85.18	9.2	23.9	25.7	12.3
05/19/98	140	140	84.11	9.3	**63.4**	25.4	**32.8**
06/16/98	88	93	26.28	67	**13.2**	7.9	6.8
06/16/98	94						
06/16/98	97.1						
07/22/98	58	58	9.41	99.9	**2.9**	2.8	1.5
08/18/98	101	101	8.61	99.9	**4.7**	2.6	2.4
09/29/98	108	108	13.33	99.8	**7.8**	4.0	4.0
09/29/98	109						
09/29/98	108						
10/26/98	70	70	25.5	69.8	**9.6**	7.7	5.0
11/01/98	2373	2373	10900	0.05	**139355.1**	3292.6	**72046.6**
07/27/99	29.2	29	56.37	13	8.9	17.0	4.6

TABLE 10-5: LITTLE TURKEY CREEK FECAL COLIFORM LOAD REDUCTION CALCULATIONS

Date	Fecal Coli. (/100ml)	Geo-Mean (/100ml)	Flow (cfs)	Flow Frequency (%)	Fecal Coli Load (10^9/day)	Standards 10^9/day	97.6% Load Reduction (10^6/day)
12/02/97	400	400	5.5	22.63	**53.8**	43.1	1.3
01/13/98	80	80	11.1	10.32	21.7	86.9	0.5
02/10/98	500	326	4.7	25.79	**37.4**	36.8	0.9
02/10/98	230						
02/10/98	300						
03/16/98	22000	22000	239	0.28	**128637.0**	1871.1	**3087.3**
04/14/98	1100	1100	3.5	32.42	**94.2**	27.4	2.3
05/19/98	400	400	3	35.49	**29.4**	23.5	0.7
06/16/98	400	400	0.3	83.04	**2.9**	2.3	0.1
07/22/98	3000	3000	0.2	88.72	**14.7**	1.6	0.4
08/18/98	1100	1265	0.2	88.72	**6.2**	1.6	0.1
08/18/98	800						
08/18/98	2300						
09/22/98	13000	13000	18	5.61	**5724.8**	140.9	137.4
09/29/98	23	23	0.8	63.7	0.5	6.3	0.0
10/26/98	200	200	1.1	57.56	5.4	8.6	0.1
11/01/98	3000	3000	347	0.12	**25468.1**	2716.6	611.2
07/27/99	400	400	1	59.55	**9.8**	7.8	0.2
				GeoMean	**63**	14	**2**

TABLE 10-6: LITTLE TURKEY CREEK TSS LOAD REDUCTION CALCULATIONS

Date	TSS (mg/L)	TSS Mean (mg/L)	Flow (cfs)	Flow Exceed (%)	TSS Load (lbs/day)	Targets (lbs/day)	22% TSS Reduction (lbs/day)
12/02/97	0.5	0.5	5.5	22.63	14.8	993.9	11.6
01/13/98	11.8	11.8	11.1	10.32	705.7	2005.8	550.4
02/10/98	12.0	11.5	4.7	25.79	291.2	849.3	227.1
02/10/98	12.0						
02/10/98	10.5						
03/16/98	1336.0	1336.0	239	0.28	**1720295.0**	43187.9	**1341830.1**
04/14/98	3.0	3.0	3.5	32.42	56.6	632.5	44.1
05/19/98	5.5	5.5	3	35.49	88.9	542.1	69.3
06/16/98	5.2	5.2	0.3	83.04	8.4	54.2	6.6
07/22/98	6.5	6.5	0.2	88.72	7.0	36.1	5.5
08/18/98	16.5	16.0	0.2	88.72	17.3	36.1	13.5
08/18/98	16.1						
08/18/98	15.5						
09/22/98	150.0	150.0	18	5.61	**14546.6**	3252.6	**11346.4**
09/29/98	3.5	3.5	0.8	63.7	15.1	144.6	11.8
10/26/98	2.0	2.0	1.1	57.56	11.9	198.8	9.2
11/01/98	629.0	629.0	347	0.12	**1175922.5**	62703.7	**917219.5**
07/27/99	8.0	8.0	1	59.55	43.1	180.7	33.6
05/18/01	172.0	172.0	178	0.37	**164948.0**	32165.0	**128659.4**
07/12/01	43.0	43.0	0.2	88.72	**46.3**	36.1	36.1
07/12/01	43.0						
09/25/01	19.0	41.7	1.6	49.01	**359.2**	289.1	280.2
09/25/01	66.0						
09/25/01	40.0						
11/13/01	44.0	42.0	0.1	94.85	**22.6**	18.1	17.6
11/13/01	40.0						
12/27/01	11.0	11.0	0.05	97	3.0	9.0	2.3
02/04/02	11.0	16.7	1.7	47.64	152.6	307.2	119.1
02/04/02	21.0						
02/04/02	18.0						
03/20/02	10.0	45.3	0.1	94.85	**24.4**	18.1	**19.1**
03/20/02	59.0						
03/20/02	67.0						

TABLE 10-7: BUFFALO CREEK FECAL COLIFORM LOAD REDUCTION CALCULATIONS

Date	Fecal Coli. (/100ml)	Geo-Mean (/100ml)	Flow (cfs)	Flow Frequency (%)	Fecal Coli Load (10^6/day)	Standards (10^6/day)	96% Load Reduction (10^6/day)
11/04/97	80	88	3.3	38.28	7101	25835	284
11/04/97	170						
11/04/97	<20						
11/04/97	220						
12/02/97	<200	200	4.3	31.49	21040	33664	842
01/13/98	1100	1100	13.7	8.83	**368688**	107255	14748
02/10/98	130	130	6.1	23.74	19401	47756	776
03/16/98	8000	8000	255	0.31	**49908600**	1996344	1996344
04/14/98	40	40	5.5	25.98	5382	43058	215
05/19/98	<200	200	4.8	29.05	23486	37578	939
06/16/98	<200	200	0.3	84.16	1468	2349	59
07/22/98	2300	2300	0.2	87.88	**11254**	1566	450
08/18/98	1100	1100					
09/22/98	50000	33019	7.1	19.9	**5735497**	55584	**229420**
09/22/98	30000						
09/22/98	24000						
09/29/98	3000	3000	1.3	60.6	**95414**	10177	3817
10/26/98	5000	5000	1.9	52.08	**232418**	14875	9297
07/27/99	<200	200	1.6	56.2			
07/27/99	<200				7829	12526	313
07/27/99	200						
07/27/99	200						
				GeoMean	**59250**	13836	2370

TABLE 10-8: BUFFALO CREEK TSS LOAD REDUCTION CALCULATIONS

Date	TSS (mg/L)	TSS Mean (mg/L)	Flow (cfs)	Flow Exceed (%)	TSS Load (lbs/day)	Targets (lbs/day)	50.5% TSS Reduction (lbs/day)
11/4/1997	4.5	4.17	3.3	38.28	74	926	37
11/4/1997	3.5						
11/4/1997	4.5						
12/2/1997	4.5	4.50	4.3	31.49	104	1206	52
1/13/1998	13	13.00	13.7	8.83	960	3843	475
2/10/1998	27.5	27.50	6.1	23.74	904	1711	447
3/16/1998	1168	1168.00	255	0.31	**1604655**	71526	**794304**
4/14/1998	24.5	24.50	5.5	25.98	726	1543	359
5/19/1998	63	63.00	4.8	29.05	**1629**	1346	806
6/16/1998	35	35.00	0.3	84.16	57	84	28
7/22/1998	35.8	35.80	0.2	87.88	39	56	19
8/18/1998	262	262.00	0.1	93.86	**141**	28	**70**
9/22/1998	1736	1767.00	7.1	19.9	**67592**	1992	**33458**
9/22/1998	1740						
9/22/1998	1825						
9/29/1998	83.3	83.30	1.3	60.6	**583**	365	289
10/26/1998	105	105.00	1.9	52.08	**1075**	533	532
7/27/1999	20	19.83	1.6	56.2	171	449	85
7/27/1999	15						
7/27/1999	24.5						

TABLE 10-9: CLEAR CREEK FECAL COLIFORM LOAD REDUCTION CALCULATIONS

Date	Fecal Coli. (/100ml)	Geo-Mean (/100ml)	Flow (cfs)	Flow Frequency (%)	Fecal Coli Load (10^6/day)	Standards (10^6/day)	97.6% Load Reduction (10^6/day)
11/04/97	800	800	2.6	39.86	**50887**	20355	1221
01/13/98	130	339	10.5	9.49	**87114**	82202	2091
01/13/98	600						
01/13/98	500						
02/10/98	130	130	4.7	24.74	14948	36795	359
03/16/98	13000	13000	215	0.34	**68379675**	1683192	1641112
04/14/98	300	300	4.3	26.84	31560	33664	757
05/19/98	800	800	3.7	30.5	**72416**	28967	1738
06/16/98	3000	3000	0.3	83.79	**22019**	2349	528
07/08/98	90000	90000	5.1	22.72	**11229435**	39927	**269506**
07/22/98	3000	1767	0.2	88.38	**8647**	1566	208
07/22/98	800						
07/22/98	2300						
08/18/98	1300	1300	0.1	94.23	**3180**	783	76
10/26/98	2700	2700	1.5	53.35	**99083**	11743	2378
11/01/98	5000	5000	311	0.12	**38043075**	2434757	913034
09/29/98	200	200	1	64.79	4893	7829	117
07/28/99	600	600	1.1	60.66	**16147**	8612	388
				GeoMean	105433	12054	**2530**

TABLE 10-10: CLEAR CREEK TSS LOAD REDUCTION CALCULATIONS

Date	TSS (mg/L)	TSS Mean (mg/L)	Flow (cfs)	Flow Exceed (%)	TSS Load (lbs/day)	Targets (lbs/day)	0% TSS Reduction (lbs/day)
11/4/1997	7	14.2	2.6	39.86	199	1297	199
1/13/1998	17.8	17.5	10.5	9.49	988	5239	988
1/13/1998	17.8						
1/13/1998	16.8						
2/10/1998	8.8	8.8	4.7	24.74	223	2345	223
3/16/1998	1067	1067.0	215	0.34	**1235952**	107275	**1235952**
4/14/1998	11	11.0	4.3	26.84	255	2146	255
5/19/1998	22	22.0	3.7	30.5	439	1846	439
6/16/1998	12.6	12.6	0.3	83.79	20	150	20
7/8/1998	335	335.0	5.1	22.72	**9205**	2545	**9205**
7/22/1998	8.66	7.7	0.2	88.38	8	100	8
7/22/1998	6.83						
7/22/1998	7.5						
8/18/1998	8.5	8.5	0.1	94.23	5	50	5
9/22/1998	4208	4208.0	9.8	10.35	**222178**	4890	**222178**
9/29/1998	<1	1.0	1	64.79	5	499	5
10/26/1998	4	4.0	1.5	53.35	32	748	32
11/1/1998	630	630.0	311	0.12	**1055600**	155175	**1055600**
7/28/1999	5.5	5.5	1.1	60.66	33	549	33

Response to Comments

on

Draft Total Maximum Daily Loads

for the

Upper Canadian River Watershed

and

Turkey Creek Watershed

Comment Period August 11, 2006 – September 11, 2006

Prepared by: USEPA Region 6

September 25, 2006

Upper Canadian River Watershed TMDL (23 TMDLs)

Turkey Creek Watershed TMDL (7 TMDLs)

Comment Period: August 11, 2006 – September 11, 2006

1. Memorandum for Diane Smith (EPA) from Mel A. McFarland (Tinker Air Force Base) dated August 24, 2006.

2. Letter from Gill (Tinker Air Force Base) to Craig (Oklahoma Department of Environmental Quality) dated July 20, 2006.

3. Comments submitted by Tinker Air Force Base for the August 23rd Public Meeting on the Proposed Upper Canadian River Watershed TMDLS

4. Memorandum for Diane Smith (EPA) from Cathy R. Sheirman (Tinker Air Force Base) dated August 31, 2006.

5. Memorandum for Diane Smith (EPA) from Mel Mc Farland (Tinker Air Force Base) dated September 11, 2006.

6. Letter received from Cloxin (Oklahoma Conservation Commission) to Smith (EPA) dated September 11, 2006.

7. Comments received form Oklahoma Farm Bureau (Peak) to Smith (EPA) dated September 11, 2006.

Memorandum to Diane Smith (EPA) from Mel A. McFarland (Tinker Air Force Base) dated August 24, 2006, and Memorandum for Diane Smith (EPA) from Cathy R. Sheirman (Tinker Air Force Base) dated August 31, 2006.

1. The commenter objects to the use of load-duration methodology and the process used by EPA for developing TMDLs in Oklahoma.

Response: The TMDL calculations presented in this report are derived from load duration curves. Load duration curves 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 load duration curve methodology has been used successfully on a National and Regional level for a wide range of pollutants. Nationally over 4000 TMDLs for bacteria have been developed using the load duration curve and other methodologies. Region 6 has established TMDLs for bacteria using the LDC methodology in Louisiana and Arkansas.

2. The commenter states that although the TMDL in question does not impact them directly, the commenter is concerned about EPA's use of the load-duration curve methodology to develop the TMDL.

3. The commenter refers to a letter sent to the Oklahoma Department of Environmental Quality in response to the draft TMDL for the North Canadian River. The commenter states it opposes the draft TMDLs for the same reasons outlined in the referenced letter and that EPA take the actions requested in the letter.

Response: The issues raised in the letter will be addressed in subsequent responses.

4. Commenter states that because the load duration curve method as used in Oklahoma is based on estimates, only one station with stream gage records was used to develop the TMDLs, the TMDLs do not consider background sources, identify specific sources, differentiate between human and animal sources of bacteria, and do not link the sources to actual sources levels of pathogens, the TMDLS are not based on sound science and should not be established.

Response: The requirements for TMDLs are outlined at 40 CFR 130.7. EPA has determined that the load duration curve methodology does meet the requirements of the regulations and TMDLs have been developed nationwide using the load duration curve methodology for bacteria. A TMDL is required to consider point sources (Waste Load Allocation) and non point sources (Load Allocation). Identification of specific individual sources in these categories is not required. EPA agrees that the information the commenter has mentioned would be beneficial and could be developed as the TMDL is implemented. The TMDL establishes the amount of loading of a particular pollutant that a waterbody can assimilate without violating the state's water quality standards.

5. The commenter states that there are processes to involve various stakeholders in determining the individual sources of bacteria in the watershed and that the TMDL does not do this.

Response: As stated in response to the previous comment, the TMDL establishes the loading of a pollutant that a given waterbody can assimilate without violating the state's water quality standards. After a TMDL has been established for a pollutant, stakeholder groups can be formed to determine how to implement the TMDL and restore the watershed to meeting the state's water quality standards.

8. The commenter requests that there be a moratorium on establishing TMDLs in Oklahoma using the load-duration methodology.

Response: As stated in previous responses, EPA believes that the load duration curve methodology is appropriate for developing TMDLs for pathogens in Oklahoma.

9. The commenter raised a number of process and procedure concerns used to establish TMDLs in Oklahoma.

a. The commenter stated that EPA did not meet the requirements of 40 CFR Part 25 in regards to public meetings. 40 CFR 25.5(b) and (c) require that an agency holding a public meeting must give notice of the meeting at least thirty days prior to the meeting and make documents available to the public for review thirty days prior to the meeting. The commenter cited the Federal Register Notice of the draft TMDLs and public meeting was published on August 11, 2006, and the public meetings were held on August 25 and 26, 2006.

Response: EPA acknowledges that it did not give public notice of the meeting thirty days before the meeting. However, the meeting that EPA held was an informal meeting to inform the public about the content of the proposed TMDLs. The administrative requirement for EPA to establish a TMDL only requires EPA to give public notice of the TMDL and respond to any comments raised by the public during the comment period; EPA is not required to hold a public meeting.

b. The commenter stated that EPA's Federal Register Notice was defective because it did not mention the meeting agenda, time or location. In addition, EPA's website did not contain any information about the public meeting and due to this the commenter was not able to adequately prepare for the public meeting.

Response: As mentioned in the previous response, EPA's administrative procedures do not require that the agency hold a public meeting pursuant to 40 CFR 25.5 as part of the public participation process when establishing TMDLs.

c. The commenter expressed concern about the length of the public comment period being too short. The commenter stated that EPA should follow the requirements of Oklahoma's Continuing Planning Process (CPP) which require a thirty day comment period after a public meeting has been held.

Response: EPA again reiterates that it is following its public participation requirements pursuant to federal regulations which allow for a thirty day comment period.

d. The commenter stated that EPA is interfering in a delegated state program and that EPA was doing this in order to meet EPA's internal deadlines.

Response: The commenter implies that the TMDL program is a delegated state program. The TMDL regulations and numerous legal actions taken against EPA have established that EPA has the ultimate responsibility for ensuring that TMDLs are established in a timely manner. EPA and the State of Oklahoma have jointly agreed that EPA would establish the bacteria TMDLs for the Upper Canadian River and Turkey Creek watersheds.

Letter from Gill (Tinker Air Force Base) to Craig (Oklahoma Department of Environmental Quality) dated July 20, 2006

The following comments were submitted on the draft TMDL for pathogens on the North Canadian River prepared by ACOG.

1. Commenter stated that the public record reflects that the TMDL will be implemented without adequate background source analysis or MS4 monitoring.

Response: The bacteria TMDLs for the Upper Canadian River and the Turkey Creek watersheds do not have an implementation component. Identification of background sources and loadings is not a required element of a TMDL. The level of information the commenter suggests that is needed for preparation of the calculation of the maximum allowable load meeting the water quality standard is not required. The information suggested by the commenter is more appropriate for a detailed implementation plan. The assimilative capacity of the stream is allocated between point and nonpoint sources. The allocation to point and nonpoint sources is the responsibility of the State, under the Water Quality Management Plan.

2. Commenter states that the goals for reduction are unattainable and that the TMDL will impose unnecessary and increasingly expensive BMPs without regard to hardship or likelihood of success.

Response: Percent reduction is informational in nature. The TMDL sets the load, not specific BMPs. The TMDL review criteria have no provisions for establishing loads based on expense or hardship. This comment addresses implementation which is not part of the TMDLs that are being established.

3. The commenter expresses a concern that unless background levels of pathogens are considered in the TMDL mandated BMPs and reduction goals the commenter and other MS4 permit holders impacted by the TMDL will be required to fund additional clean-up of pathogens from sources over which they have no control.

Response: The impaired segments do not include any MS4 permittees and therefore the question is moot in regard to these TMDLs. EPA established TMDLs may contain references to specific BMPs as a guide to be used in implementing the TMDL. Although, EPA regulations do not require that implementation be included in the TMDL report, EPA strongly supports TMDLs that do include an implementation component. Additionally, EPA notes that a permittee is only required to demonstrate that their discharge will meet the water quality standard criteria or their individual wasteload allocation and is not responsible for the clean-up of discharges that the permittee has no control over.

5. The commenter states that the proposal is not in compliance with Oklahoma statutes or Federal Water Pollution Control Act.

Response: The TMDLs are being established by EPA and meet the requirements of the Clean Water Act, which makes the Oklahoma statues and CPP moot.

6. The commenter raised concerns about Oklahoma’s administrative procedures in regards to establishing TMDLs.

Response: The comment is moot due to the fact that EPA is following Federal administrative procedures in establishing the TMDLs.

Comments submitted by Tinker Air Force Base during the August 23rd Public Meeting on the Proposed Upper Canadian River Watershed TMDLS

1. The commenter questions if the background levels of bacteria in the Canadian River are being exceeded prior to entering Oklahoma.

Response: Segment 520620050010_00 is the first segment of the Canadian River in Oklahoma and is not listed on the 2002 303(d) list as being impaired for pathogens. The next downstream segment is 520620040010_00 and it is also not listed on the 2002 303(d) list for pathogens. Segment 520620030010_00 the next downstream segment is listed on the 2002 303(d) list as being impaired by pathogens.

2. The commenter states that the waterbodies designated use is inappropriate and should be based on land use. The commenter states that primary or secondary body contact recreation uses are inappropriate.

Response: The designated uses of the waterbodies are determined by the State of Oklahoma. The state has determined that the waterbodies have a use of primary contact recreation. The State of Oklahoma does have procedures for removing and changing uses for waterbodies. EPA refers the commenter to the Oklahoma Water Resources Board for further information on this process.

3. Commenter questioned the statement "only a small fraction of these fecal coliform are expected to represent loading into waterbodies," referring to the sources listed in (Tables 3-6, 3-7). The commenter notes that the watersheds are primarily agricultural and no evidence was presented to support this assertion.

Response: Tables 3-6 and 3-7 give estimates of the magnitude of the loading in the watersheds from livestock. This information is presented for informational purposes only; the loadings in the TMDL were derived from the sample data collected in the waterbodies.

4. The commenter states the assumption that all septic tanks were considered to be failing is not a reasonable assumption.

Response: The information on septic tanks was again for informational purposes only. The actual TMDLs were calculated from sample data collected in the waterbodies.

5. Commenter states that urban/suburban rates of pet ownership are only gross estimates of pets in rural areas which tend to have more dogs and cats per capita.

Response: Comment noted.

6. Commenter questions if it is valid to assume that the entire fecal load from dogs and cats reaches the waterbodies in question.

Response: Table 3-13 gives an estimate of the possible magnitude of the loadings from pets. As stated in previous responses, the TMDL is based on the actual sample data collected in each waterbody.

7. The commenter suggests that Table 3-13 has too many assumptions to be even remotely accurate.

Response: As stated in our responses the estimated loadings in Table 3-13 were not used to calculate the TMDLs. Table 3-13 is an attempt to identify sources of pollution that may need to be addressed during the implementation of the TMDLs.

8. The commenter states that there are no valid stream gage stations in the watershed to base the watersheds' flow duration curves on. Real flow data is required to calculate pathogen loads. The commenter questions if the primary body contact recreation use is correct given the extremely low flows of a number of the waterbodies.

Response: Flow duration curves were estimated from measured data from just downstream of segment 520620020010_00 and from stream gage data from a station on Deer Creek. The use of data from other waterbodies to develop flow curves for a waterbody has been used by EPA and state agencies to develop TMDLs in the absence of flow data for the impaired waterbody. EPA again defers to the Oklahoma Water Resources Board on the issue of the appropriateness of the primary body contact recreation use designation for the waterbodies.

9. The commenter states that flow data from downstream of the study area was used to develop the TMDLs and has asked why the draft report does not contain a flow curve for the monitoring station and if there is any monitoring data available for that site.

Response: A flow curve for the monitoring station was not deemed to be necessary for the project and therefore was not prepared. USGS gage 07228500 is located in segment OK520610020150_00 which has been placed on the on 2002 303(d) list as being impaired by pathogens. The development of a TMDL for this segment is beyond the scope of this report; however EPA expects a pathogen TMDL to be developed for this segment in the future.

10. Commenter states that due to the lack of actual stream gage data in the watersheds, identification of the actual sources of the impairment, the use of literature assumptions and other gross assumptions, the waterbodies should not have been classified as Category 5 waterbodies.

Response: The waterbodies were placed in Category 5 based on actual measurements and monitoring data collected from the specific streams, not assumptions. The decision to place the waterbodies in question on the 303(d) list was reviewed by EPA and the public. This information and subsequent data that has been developed was considered in the process of establishing these TMDLs.

Memorandum to Diane Smith (EPA) from Mel Mc Farland (Tinker Air Force Base) dated September 11, 2006.

1. The commenter mentions the letter sent from Miguel Flores (EPA) to Jon Craig (ODEQ) and has included it as an attachment. The commenter states that the letter indicates EPA is taking over the public participation process for these TMDLs, and that EPA will establish these TMDLs in place of action by ODEQ. The stated reason for this action is to complete the TMDL process by 30 Sep 2006, a deadline internal to EPA.

Response: The letter states that Oklahoma had committed to establishing 38 TMDLs by September 30, 2006, and had, to date, only established 2 TMDLs and that Oklahoma indicated that it would not be able to meet its commitment of establishing 38 TMDLs by September 30, 2006. EPA strongly believes that significant progress in establishing TMDLs in Oklahoma needs to be made this fiscal year. Due to these reasons and not a desire to avoid public participation EPA chose to establish these 30 TMDLs.

2. The commenter states that EPA is deliberately avoiding public participation by taking this action.

Response: As stated above, EPA has determined that significant progress in establishing TMDLs in Oklahoma needs to be made by September 30, 2006, and that in order for progress to be made, EPA has chosen to establish the TMDLs in question.

3. Such action is contrary to federal case law. The court in Environmental Defense Fund, Inc. v. Costle, 657 F.2d 275 (D.C.Cir. 1981), interpreted subsections (c)(1),(c)(2)(A) and (c)(4)(b) of Section 303 of the Clean Water Act (CWA), 33U.S.C. Section 1313(c)(1), (c)(2)(A) and (c)(4)(B)(copy of case attached). Those sections require the states to set water quality standards, and submit them to EPA for review, but they also allow EPA to set water quality standards where new or revised standards are necessary to meet the requirements of Subchapter III. The court stated as follows:

[I]t is logical that EPA should refrain from acting until the states have completed an initial effort to update the standards as they deem appropriate. Environmental Defense Fund v. Costle, 657 F.2d 275 at 294 (footnote omitted).

Although the court was examining subsection (c) of Section 303, the analysis is equally applicable to subsection (d) which immediately follows. This portion of Section 303 requires states to, among other things, establish TMDLs and submit them to EPA for review. The state of Oklahoma is making progress toward establishing TMDLs for the Canadian River or Turkey Creek. The EPA letter reflects that the TMDLS for these watersheds are already in draft form and that EPA has them in hand. Paragraph three of the letter states:

Region 6 has recently draft TMDL reports addressing impairments for pathogens and/or turbidity in Upper Canadian River and the Turkey Creek watersheds from DEQ.

Since Oklahoma is making adequate progress toward establishing TMDLs for these watersheds, under Costle, EPA should refrain from acting until Oklahoma has completed its initial effort to establish these TMDLs.

Response: The commenter has stated its opinion that Oklahoma is making adequate progress toward establishing the TMDLs in question. EPA does not concur with this opinion. In the letter quoted by the commenter, EPA noted that the state of Oklahoma informed EPA that the state would not be able to meet its commitment to EPA to establish the TMDLs by the date agreed to by both agencies of September 30, 2006, and because of this reason EPA would proceed with establishing the TMDLs.

The commenter cites the court decision on Costle which states that EPA should refrain from acting to establish water quality standards in lieu of the state. The commenter suggests that this decision based on Section 303 (c) of the Clean Water Act is applicable to Section 303 (d) of the Clean Water Act. EPA does not concur with this conclusion and EPA has and continues to establish TMDLs for impaired waters in both Arkansas and Louisiana.

4. This action is also contrary to stated Congressional policy. As the court in Costle noted:

This [Section 101(b) of the CWA] recognizes the Congressional policy of placing "primary" responsibility with the state "to prevent, reduce, and eliminate" water pollution. Id,

Response: The commenter states that EPA's actions are contrary to Congressional policy. EPA does not concur. The commenter cites that primary responsibility has been give to the states to prevent, reduce and eliminate water pollution. The TMDLs in question establish the maximum loading for each waterbody in the report and partition the loading between point and non point sources; they do not prevent, reduce or eliminate water pollution. The implementation of the TMDLs, which will be the state's responsibility, will prevent, reduce and eliminate water pollution.

5. Under the facts set out in this memorandum, EPA does not have the statutory authority to establish TMDLs in place of Oklahoma. A comparison of subsections (c) and (d) of Section 303 reveals why. Subsection (c) provides for the states to review, modify and adopt water quality standards and submit them for review to EPA, and subsection (c)(4)(B) has an additional provision for EPA to set water quality standards in <u>any</u> case where EPA determines a new or revised standard is necessary. However, subsections (d)(1)(C) and (d)(2) require the states to set TMDLs and submit them to EPA for approval. Subsection (d)(2) allows EPA to establish TMDLs in place of a state <u>only</u> when it has disapproved a TMDL. There is no language in the Federal Register notice for these TMDLs or in the EPA letter that disapproves Oklahoma's draft TMDLs for the Upper Canadian or Turkey Creek watersheds. Rather, EPA intends to establish these same draft TMDLs as final. Thus, EPA has not disapproved Oklahoma's draft TMDLs and has not statutory authority to take over the public participation process or to establish the TMDLs for these watersheds.

Response: EPA does not concur that EPA can <u>only</u> establish a TMDL after it has disapproved a TMDL. Subsection (d)(2) requires EPA to establish a load if the agency has disapproved the load. The word <u>only</u> does not appear in the statute. EPA has established TMDLs in other Region 6 states without having disapproved the TMDL.

Oklahoma has only submitted the TMDLs in question to EPA for technical review and not final approval.

The state of Oklahoma has not submitted comments objecting to this EPA action. In fact, EPA has received a letter from the Oklahoma Conservation Commission expressing their support for the TMDLs.

Letter received from Cloxin (Oklahoma Conservation Commission) to Smith (EPA) dated September 11, 2006

1. The commenter expressed his support of EPA establishing the TMDLs for the Upper Canadian River and the Turkey Creek Watershed

Response: EPA appreciates the comment of interest, and support of these TMDLs.

Comments received form Oklahoma Farm Bureau (Peak) to Smith (EPA) dated September 11, 2006.

UPPER CANADIAN RIVER WATERSHED AND TURKEY CREEK WATERSHED TMDLS

1. Oklahoma Farm Bureau points out that there is an incorrect statement on page 5-46 of the Upper Canadian River Watershed and page 46 of the Turkey Watershed TMDLs. The statement in question is "Nonpoint source pollution is regulated by the Oklahoma Conservation Commission." The commenter states that the Oklahoma Department of Agriculture Food and Forestry has jurisdiction over nonpoint source runoff from agricultural crop production, agricultural services, livestock production, silviculture, feed yards, livestock markets and animal waste. Other nonpoint source jurisdiction is divided among the Oklahoma Department of Environmental Quality, Oklahoma Corporation Commission, and the Department of Mines.

The Oklahoma Conservation Commission (OCC) is responsible for the monitoring, evaluation and assessment of waters to determine the condition of streams and rivers being impacted by nonpoint source pollution. The OCC is the technical lead agency for nonpoint source categories as defined in Section 319 of the federal Clean Water Act or other subsequent federal or state nonpoint source programs, except for activities related to industrial and municipal storm water or as otherwise provided by state law.

Response: The final report has been changed to reflect this comment.

2. Oklahoma Farm Bureau does not concur that TMDLs must be based on attainment of the current standards. They're concerned that when waterbodies in remote areas of the state with sparse population are labeled as impaired, either the beneficial use may be inappropriate, and/or the standard is questionable. For example, in some areas of the Upper Canadian watershed the biggest contributors of bacteria to the waterbodies will be wildlife and cattle.

They support Use Attainability Analyses (UAA) being performed on the creeks in the Upper Canadian River watershed and the Turkey Creek Watershed to verify whether Primary Body Contact Recreation is the appropriate beneficial. They request that UAAs be performed for:

Upper Canadian River		Turkey Creek	
OK520620010120	Bear Creek	OK620910060010	Turkey Creek
OK520620020090	Trail Creek	OK620910060020	Little Turkey Creek
OK520620030020	Lone Creek	OK620910060030	Buffalo Creek
OK520620030050	Red Trail Creek	OK620910060110	Clear Creek
OK520620030110	Red Creek		
OK520620040050	Hackberry Creek		
OK520620050160	Commission Creek		
OK520620060010	Deer Creek		

Response: The revision of the Oklahoma Water Quality Standards to address the issues raised by the commenter is beyond the scope of the proposed action. We support UAAs being done to verify if Primary Body Contact Recreation is the appropriate beneficial use, however, that also is an action outside the scope of the proposed action. EPA refers the commenter to the Oklahoma Water Resources Board for further information on this process. Finally, EPA’s regulations and procedures require that TMDLs be developed to meet the current water quality standard and cannot be based on a less stringent standard.