

**NEOSHO BASIN TOTAL MAXIMUM DAILY LOAD**

**Water Body/Assessment Unit: Cow Creek (Lawton)  
Water Quality Impairment: Sulfate**

**1. INTRODUCTION AND PROBLEM IDENTIFICATION**

<b>Subbasin:</b>	Spring	<b>County:</b>	Crawford and Cherokee
<b>HUC 8:</b>	11070207		
<b>HUC 11 (HUC 14s):</b>	150 (010, 020, 030, 040, and 050)		
<b>Drainage Area:</b>	760 square miles		
<b>Main Stem Segment:</b>	WQLS: 16 (Cow Creek (Lawton)) starting at the confluence with the Spring River and traveling upstream to headwaters in southeast Crawford County ( <b>Figure 1</b> ).		
<b>Tributaries:</b>	Long Branch (21) Taylor Branch (25) Brush Cr (26) E. Cow Cr (24) First Cow Cr (27) Clear Cr (28)		
<b>Designated Uses:</b>	Special Aquatic Life Support, Primary Contact Recreation (Not open to and accessible by the public), Domestic Water Supply; Food Procurement; Ground Water Recharge; Industrial Water Supply Use; Irrigation Use; Livestock Watering Use for Main Stem Segment (Cow Creek (Lawton))		
<b>Impaired Use:</b>	Domestic Water Supply		
<b>Water Quality Standard:</b>	Domestic Water Supply: 250 mg/L at any point of domestic water supply diversion (K.A.R.28-16-28e(c) (3) (A)); Livestock Watering: 1,000 mg/L (Table 1a of K.A.R. 28-16-28e(d));  In stream segments where background concentrations of naturally occurring substances, including chlorides and sulfates, exceed the domestic water supply criteria listed in table 1a in subsection (d), at ambient flow, due to intrusion of mineralized groundwater, the existing water quality shall be maintained, and the newly established numeric criteria for domestic water supply shall be the background concentration, as defined in K.A.R. 28-		

# Cow Creek (Lawton) TMDL Reference Map

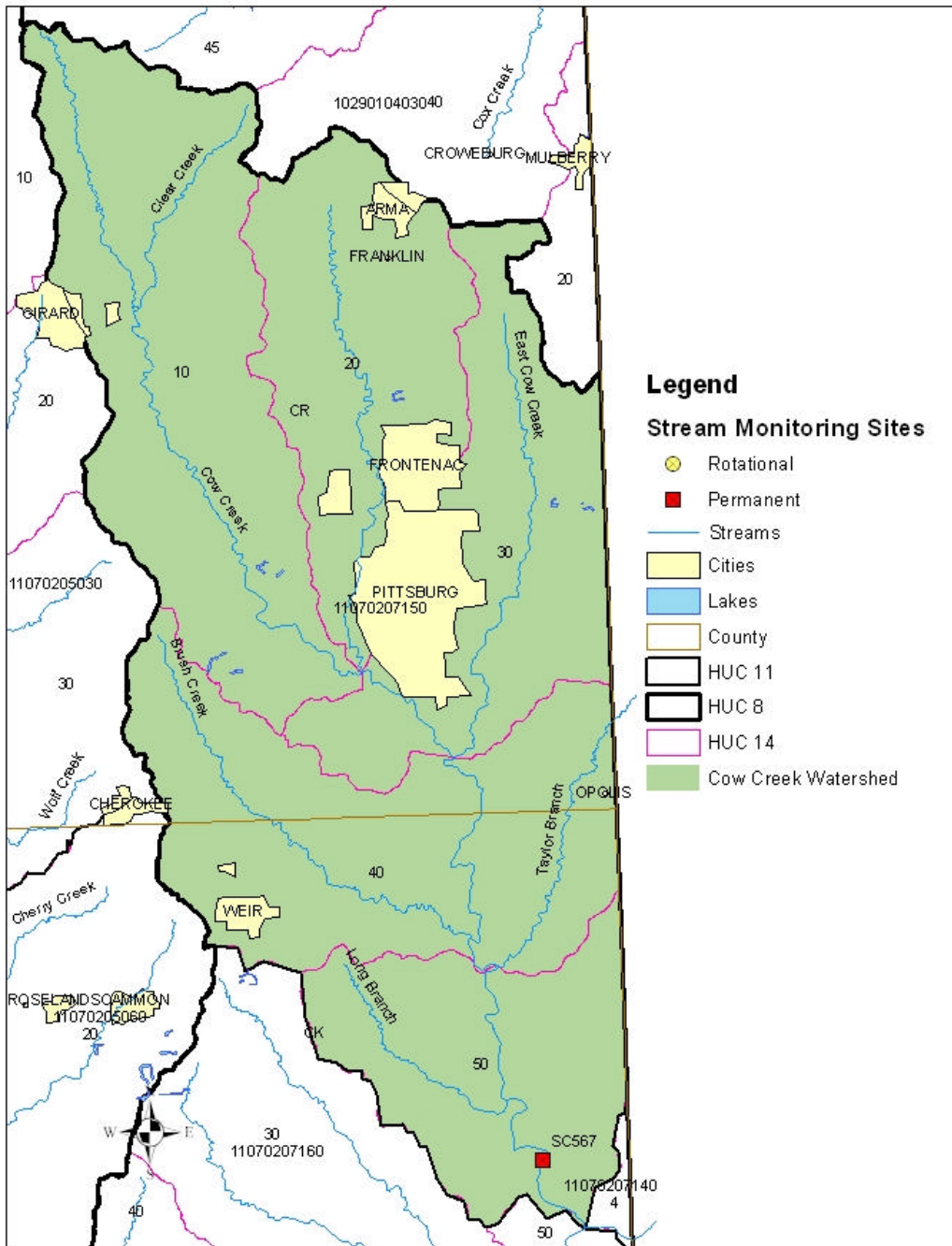


Figure 1

16-28b(e). Background concentrations shall be established using the methods outlined in the “Kansas implementation procedures: surface water quality standards,” as defined in K.A.R. 28-16-28b(ee), available upon request from the department. (K.A.R. 28-16-28e(c) (3)(B))

## 2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

**Level of Support for Designated Use under 2002 303(d):** Not Supporting Domestic Water Supply

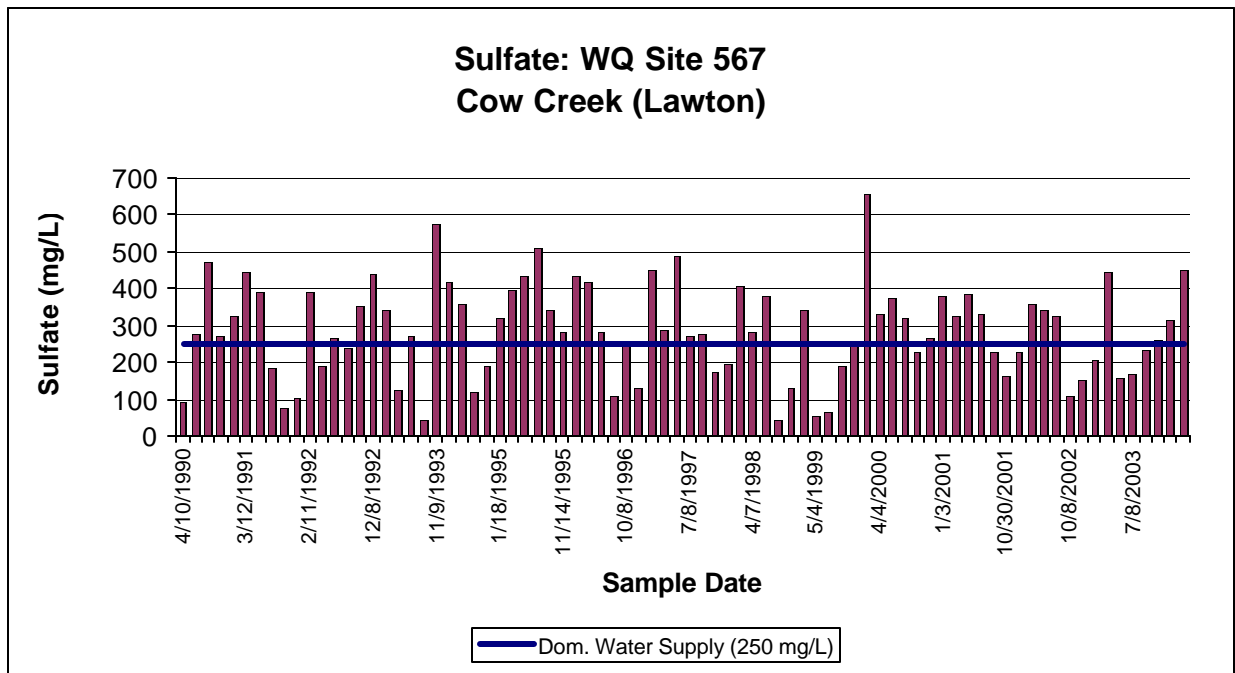
**Monitoring Sites:** Station 567 near Lawton

**Period of Record Used:** 1990–2004 for Station 567

**Flow Record:** Cow Creek near Weir, KS (USGS Station 07186040); 1976 - 1982 and Spring River near Quapaw, OK (USGS Station 07188000); 1974 - 2004.

Current Cow Creek flows were calculated from a regression of the Cow Creek near Weir flows versus Spring River near Quapaw flows from 1976 to 1982.

**Long Term Flow Conditions:** Median Flow = 27.1 cfs



**Figure 2**

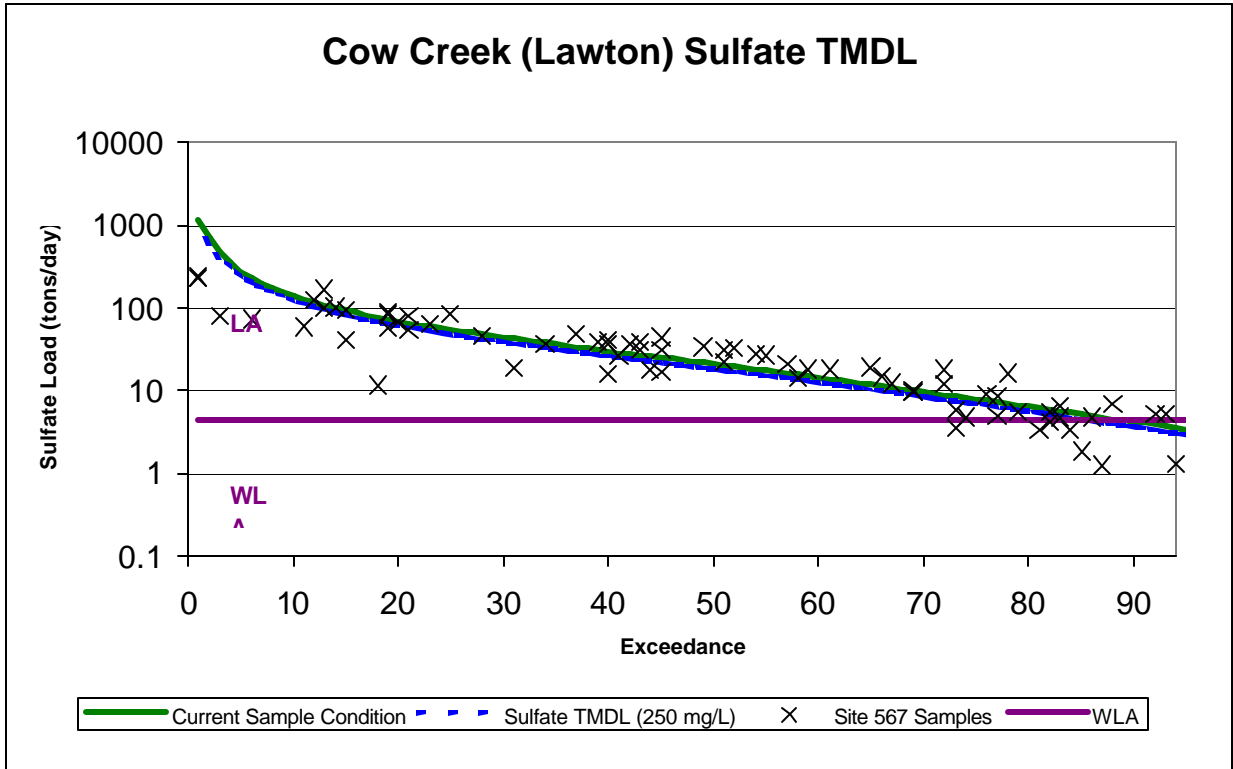


Figure 3

**Current Conditions:** Since loading capacity varies as a function of the flow present in the stream, this TMDL represents a continuum of desired loads over all flow conditions, rather than fixed at a single value. High flows and runoff equate to lower flow durations; baseflow and point source influences generally occur in the 75-99% range. Load curves were established for the Domestic Water Supply criterion by multiplying the flow values along the curve by the applicable water quality criterion and converting the units to derive a load duration curve of tons per day. These load curves represent the TMDL since any point along the curve denotes water quality for the standard at that flow. Historic excursions from the water quality standard are seen as plotted points above the load curve. Water quality standards are met for those points plotting below the load duration curve (**Figure 3**).

Excursions were seen in each of the three defined seasons and are outlined in **Table 1**. Seventy-three percent of the Spring samples and 33% of Summer-Fall samples were over the 250 mg/l criterion. Seventy-two percent of the Winter samples were over the sulfate criterion. Overall, 63% of the samples were over the criteria. This would represent a baseline condition of non-support of the impaired designated use.

Table 1

NUMBER OF SAMPLES OVER SULFATE STANDARD OF 250 mg/L BY FLOW								
Station	Season	0 to 10%	10 to 25%	25 to 50%	50 to 75%	75 to 90%	90 to 100%	Cum. Freq.
Cow Creek near Lawton (567)	Spring	0	6	8	6	1	1	22/30 = 73%
	Summer/Fall	0	0	1	4	2	0	7/21 = 33%
	Winter	0	5	4	6	4	2	21/29 = 72%

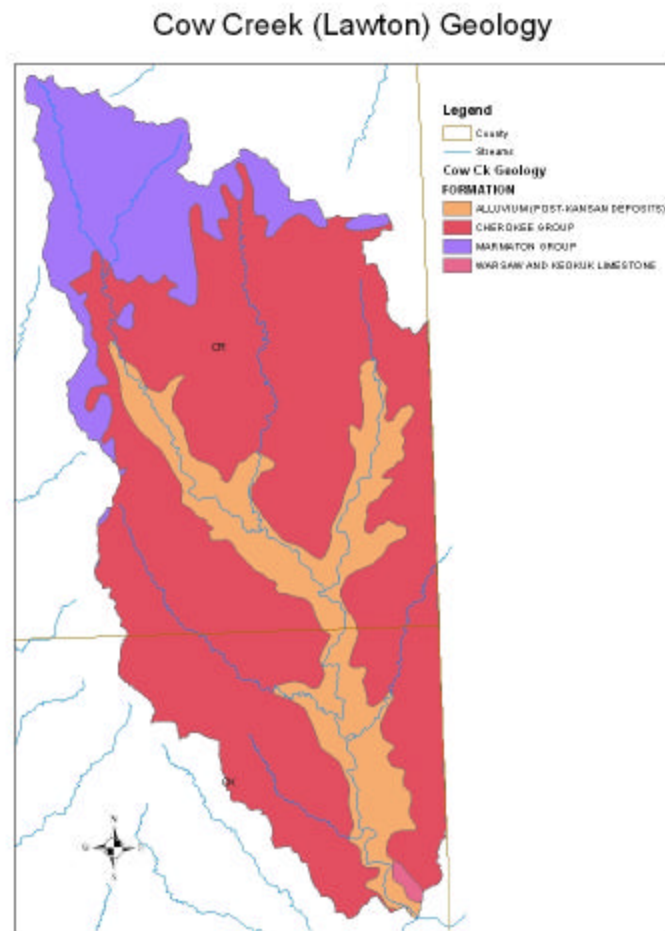
## Desired Endpoints of Water Quality (Implied Load Capacity) at Site 567 over 2007 – 2011

The ultimate endpoint for this TMDL will be to achieve the Kansas Water Quality Standards fully supporting Drinking Water Use. The current standard of 250 mg/L of sulfate was used to establish the TMDL (**Table 2**). The main stem and tributaries often have elevated sulfate levels from overflow and seepage from strip pits in the watershed.

Seasonal variation has been incorporated in this TMDL through the documentation of the seasonal consistency of sulfate level exceedances. Achievement of the endpoints indicate loads are within the loading capacity of the stream, water quality standards are attained and full support of the designated uses of the stream have been restored.

Parameter	Current Condition	TMDL	Percent Reduction
Sulfate (mg/L)	286	250	13%

### 3. SOURCE INVENTORY AND ASSESSMENT



**Figure 4**

**Geology:** The high sulfate concentrations in the Cow Creek watershed are derived from the oxidation of the sulfide in pyrite (iron sulfide) in the carbonaceous shales and coal in the bedrock as a result of the exposure of the rock and coal to the atmosphere and water containing dissolved oxygen (Figure 4). The mining of coal exposed the bedrock containing the pyrite to the oxidation process. Pyrite remaining in the spoil material can continue to weather to release sulfate.<sup>1</sup>

Coal mining strip pits are located throughout the watershed. A Kansas Geological Survey report showed that the mined land in the Cow Creek watershed is affected by overflow and seepage from strip pits, and the resulting sulfate levels average 1458 mg/L. Reclaimed mined land has improved water quality averaging 693 mg/L of sulfate.<sup>2</sup>

The U.S. Geological Survey found a strong correlation between the sulfate ion concentration and the percentage of drainage area strip-mined. The sulfate concentrations of the Cow Creek subwatersheds range from 380 to 1,100 mg/L. The percentage of strip-mined area in these subwatersheds ranged from 7.7% to 38% of the total land area.<sup>3</sup>

**NPDES:** There are nine NPDES municipal permitted wastewater dischargers located within the watershed that would contribute a sulfate load to Site 567 (**Figure 5**). These systems are outlined below in **Table 3**. The dissolved sulfate found in municipal wastewater is expected to be of natural origin derived from the source water.

**Table 3**

Kansas Permit Number	Facility Name	Facility Type	Influent Source	Design Flow (MGD)	SO4 in Influent (mg/L)	SO4 in Effluent (mg/)	WLA (tons/day)
C-NE57-OO03	ABLE DESIGN PLASTICS WTF	Activated Sludge	PITTSBURG	0.005	56.87	158	0.003
C-NE57-OO02	OAK HILL MOBILE HOME PARK	Two Cell Lagoon	PITTSBURG	0.009	56.87	240	0.009
C-NE67-OO01	BRADFORD ACRES	Two Cell Lagoon	WEIR	0.013	30.88	240	0.013
C-NE57-TO01	WESTWOOD ESTATES	Activated Sludge	PITTSBURG	0.023	56.87	160	0.015
I-NE57-CO01	MISSION CLAY PRODUCTS	Cooling Water	PITTSBURG	0.053	56.87	160	0.035
M-NE67-OO01	WEIR MWTP	Three Cell Lagoon	WEIR	0.085	30.88	240	0.085
M-NE03-OO01	ARMA MWTP	Four Cell Lagoon	ARMA	0.264	45.25	240	0.265
M-NE27-OO01	FRONTENAC MWTP	Five Cell Lagoon	FRONTENAC	0.610	35.4	240	0.611
M-NE57-OO01	PITTSBURG MWTP	UV Disinfection	PITTSBURG	5.936	56.87	161	3.993

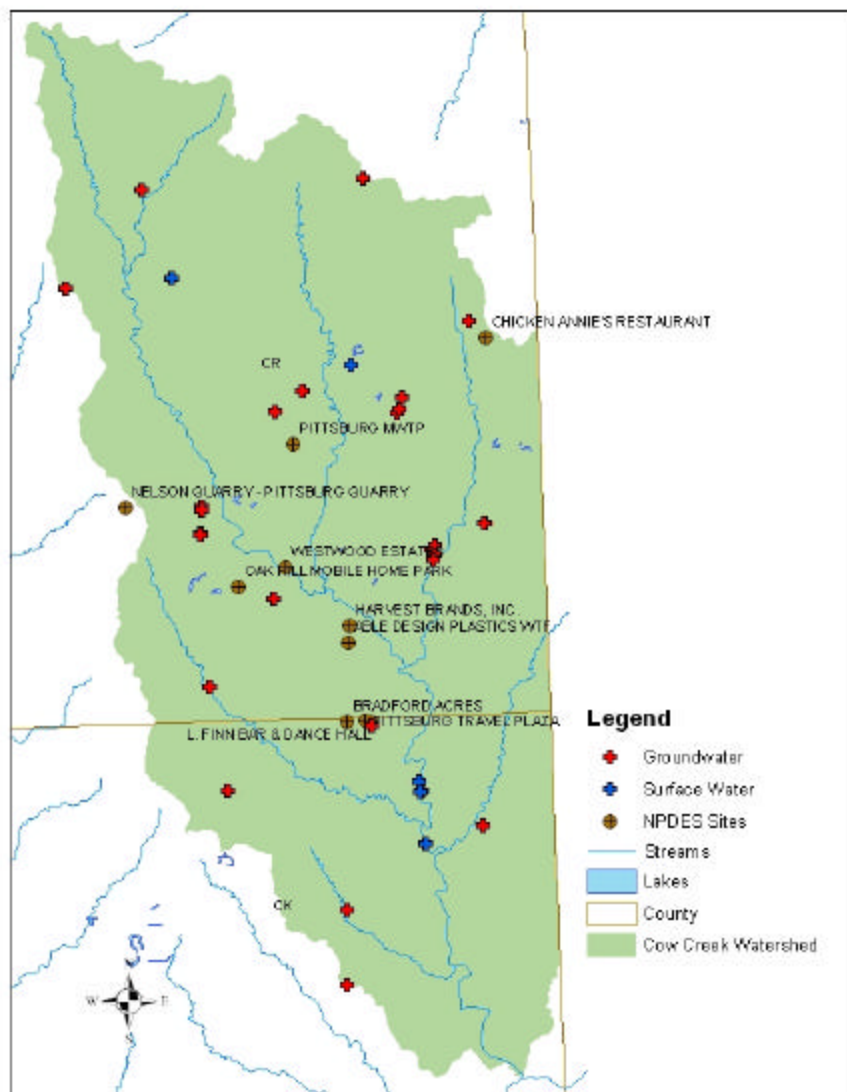
<sup>1</sup> Whittemore, D. (25 Mar 2004). Mined Land Lake sulfate - short answer.

<sup>2</sup> Welch, J.E. & Hambleton, W.W. 1982. *Environmental Effects of Coal Surface Mining and Reclamation on Land and Water in Southeastern Kansas*. Kansas Geological Survey Mineral Resources Series 7.

<sup>3</sup> Bevans, H.E. 1980. *A Procedure for Predicting Concentrations of Dissolved Solids and Sulfate Ion in Streams Draining Areas Strip Mined for Coal*. U.S. Geological Survey. Water-Resources Investigations Open-File Report 80-764.

The sulfate concentrations for Able Design Plastics WTF and the Pittsburg MWTP are based on one year of effluent data. These average concentrations should be approximately equal to the influent source. However, the actual effluent concentration is almost three times higher than the influent concentration. Because of the increased probability of evaporation, the sulfate levels in the lagoons should be more concentrated than those in the mechanical plants. Therefore, the sulfate concentration for the lagoons is set at 240 mg/L, just below the water quality standard. The two remaining mechanical plants, Westwood Estates and Mission Clay Products, are held at 160 mg/L, a similar concentration to the other mechanical plants.

### Cow Creek (Lawton) NPDES Sites and Points of Diversion



**Figure 5**

The four facilities have a non-discharging lagoon that may contribute a sulfate load to Cow Creek (Segment 16) under extreme precipitation events (stream flows associated with such events are typically exceeded only 1 - 5 % of the time). Such events would not occur at a frequency or of a duration that would impair the designated uses of the river. All non-discharging lagoon systems are prohibited from discharging to the surface waters of the state. Under standard conditions of these non-discharging facility permits, when the water level of the lagoon rises to within two feet of the top of the lagoon dikes, the permit holder must notify KDHE. Steps may be taken to lower the water level of the lagoon and diminish the probability of a bypass of sewage during inclement weather. Bypasses may be allowed if there are no other alternatives and 1) it would be necessary to prevent loss of life, personal injury or severe property damage; 2) excessive stormwater inflow or infiltration would damage the facility; or 3) the permittee has notified KDHE at least seven days before the anticipated bypass. Any bypass is immediately report to KDHE. All four of the non-discharging lagoons plus one non-discharging, industrial plant are listed in **Table 4**.

**Table 4**

<b>Kansas Permit Number</b>	<b>Facility Name</b>	<b>Facility Type</b>	<b>Design Flow (MGD)</b>	<b>WLA (tons/day)</b>
C-NE57-NO03	GIRL SCOUT COUNCIL OF THE OZWARK AREA	One Cell Lagoon	Non-discharging	0.0
C-NE57-NO04	CHICKEN MARY'S RESTAURANT	One Cell Lagoon	Non-discharging	0.0
C-NE57-NO05	CHICKEN ANNIE'S RESTAURANT	Two Cell Lagoon	Non-discharging	0.0
C-NE57-NO06	L. FINN BAR & DANCE HALL	Two Cell Lagoon	Non-discharging	0.0
I-NE57-NP01	HARVEST BRANDS, INC.	Lift Station & Sludge	Non-discharging	0.0

**Irrigation Return Flows:** The irrigation impact on the mined land watershed is minimal. The volume of surface water (4,740 acre-feet) used for irrigation would not influence the sulfate content significantly. Reports from 2003 indicate that 746 acres of land are irrigated in the Cow Creek watershed. The locations of the points of diversion are shown in figure 5.

#### **4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY**

The source assessment has ascertained that strip-mining activity within the watershed is overwhelmingly responsible for the excursions seen at station 567 located within the Cow Creek watershed.

**Point Sources:** Based on an estimated discharge volume from all point sources contributing to station 567 (7.00 MGD = 10.8 cfs) and the current effluent concentrations below 250 mg/l, a Wasteload Allocation of up to 5.0 tons per day will be established by this TMDL. **Tables 3 and 4** detail the calculations used to estimate the Wasteload allocations.



**Nonpoint Sources:** The Load Allocation based on the existing standard of 250 mg/L across all flow conditions is shown in Figure 3 and is 18.3 tons per day at median flow (27.1 cfs).

**Defined Margin of Safety:** Adherence to the 250 mg/l endpoint at all flow conditions provides an explicit assurance that sulfate levels will not impair any potential use of the stream. Additionally, explicitly maintaining a WLA based upon a 160 mg/L sulfate target for mechanical plants and 240 mg/L sulfate target for lagoons ensures WLA will not cause sulfate concentrations to exceed 250 mg/L.

**State Water Plan Implementation Priority:** Because the sulfate impairment in the Cow Creek watershed is due to prior strip-mining activity, this TMDL will be a Low Priority for implementation.

**Unified Watershed Assessment Priority Ranking:** This watershed lies within the Spring Basin (HUC 8: 11070207) with a priority ranking of 16 (High Priority for restoration).

**Priority HUC 11s and Stream Segments:** Because of the strip pits are present throughout the watershed, no priority subwatersheds or stream segments will be identified.

## **5. IMPLEMENTATION**

### **Desired Implementation Activities**

1. Monitor any anthropogenic contributions of sulfate loading to river.
2. Minimize irrigation return flows
3. Reclaim strip mining areas

### **Implementation Programs Guidance**

#### **NPDES and State Permits - KDHE**

- a. NPDES and state permits for facilities for facilities in the watershed will be renewed after 2004 with sulfate monitoring and any appropriate permit limits which protects the domestic water supply criteria at any emerging point of diversion on these streams.

#### **Non-Point Source Pollution Technical Assistance - KDHE**

- a. Evaluate any potential anthropogenic activities that might contribute sulfate to the river as part of an overall Watershed Restoration and Protection Strategy.

#### **Water Right Management – KDA/DWR**

- a. Encourage proper use of tailwater control practices to minimize irrigation return flows.

#### **Surface Mining Section – KDHE**

- a. Encourage the reclamation of strip mining areas

**Timeframe for Implementation:** Continued monitoring over the years from 2002 to 2007.

**Targeted Participants:** Primary participants for implementation will be KDHE.

**Milestone for 2007:** The year 2007 marks the midpoint of the ten-year implementation window for the watershed. At that point in time, sampled data from the Cow Creek watershed should indicate no evidence of increasing sulfate levels relative to the conditions seen in 1990-2004. Should the case of impairment remain, source assessment, allocation and implementation activities will ensue.

**Delivery Agents:** The primary delivery agents for program participation will be the Kansas Department of Health and Environment.

**Reasonable Assurances:**

**Authorities:** The following authorities may be used to direct activities in the watershed to reduce pollution.

1. K.S.A. 65-171d empowers the Secretary of KDHE to prevent water pollution and to protect the beneficial uses of the waters of the state through required treatment of sewage and established water quality standards and to require permits by persons having a potential to discharge pollutants into the waters of the state.
2. K.S.A. 2-1915 empowers the State Conservation Commission to develop programs to assist the protection, conservation and management of soil and water resources in the state, including riparian areas.
3. K.S.A. 75-5657 empowers the State Conservation Commission to provide financial assistance for local project work plans developed to control nonpoint source pollution.
4. K.S.A. 82a-901, et seq. empowers the Kansas Water Office to develop a state water plan directing the protection and maintenance of surface water quality for the waters of the state.
5. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the *Kansas Water Plan*.
6. The *Kansas Water Plan* and the Neosho Basin Plan provide the guidance to state agencies to coordinate programs intent on protecting water quality and to target those programs to geographic areas of the state for high priority in implementation.

**Funding:** The State Water Plan Fund, annually generates \$16-18 million and is the primary funding mechanism for implementing water quality protection and pollution reduction activities in the state through the *Kansas Water Plan*. The state water planning process, overseen by the Kansas Water Office, coordinates and directs programs and funding toward watersheds and water resources of highest priority. Typically, the state allocates at least 50% of the fund to

programs supporting water quality protection. This watershed and its TMDL are a Low Priority consideration.

**Effectiveness:** The Kansas Geological Survey has shown that reclaiming mined land is an effective way to reduce the sulfate loading to streams.

## 6. MONITORING

KDHE will continue to collect bimonthly samples at Station 567, including sulfate samples, in each of the three defined seasons. Based on that sampling, the priority status will be evaluated in 2007. Should impaired status remain, the desired endpoints under this TMDL will be refined and direct more intensive sampling will need to be conducted under specified seasonal flow conditions over the period 2007-2011.

Monitoring of sulfate levels in effluent will be a condition of NPDES and state permits for facilities. This monitoring will continually assess the contributions of sulfate in the wastewater effluent released to the stream.

## 7. FEEDBACK

**Public Meetings:** Public meetings to discuss TMDLs in the Neosho Basin were held January 9, 2002 in Burlington, March 4, 2002 in Council Grove, and July 30, 2004 in Marion. An active Internet Web site was established at <http://www.kdhe.state.ks.us/tmdl/> to convey information to the public on the general establishment of TMDLs and specific TMDLs for the Neosho Basin.

**Public Hearing:** Public Hearings on the TMDLs of the Neosho Basin were held in Burlington and Parsons on June 3, 2002.

**Basin Advisory Committee:** The Neosho Basin Advisory Committee met to discuss the TMDLs in the basin on October 2, 2001, January 9, March 4, and June 3, 2002.

**Discussion with Interest Groups:** Meetings to discuss TMDLs with interest groups include:  
Kansas Farm Bureau: February 26 in Parsons and February 27 in Council Grove

**Milestone Evaluation:** In 2007, evaluation will be made as to the degree of implementation that has occurred within the watershed and current condition of the Cow Creek watershed. Subsequent decisions will be made regarding the implementation approach and follow up of additional implementation in the watershed.

**Consideration for 303(d) Delisting:** The wetland will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2007-2011. Therefore, the decision for delisting will come about in the preparation of the 2012 303(d) list. Should modifications be made to the applicable water quality criteria during the ten-year implementation period, consideration for delisting, desired endpoints of this TMDL and implementation activities may be adjusted accordingly.

**Incorporation into Continuing Planning Process, Water Quality Management Plan and the Kansas Water Planning Process:** Under the current version of the Continuing Planning Process, the next anticipated revision will come in 2003 that will emphasize revision of the Water Quality Management Plan. At that time, incorporation of this TMDL will be made into both documents. Recommendations of this TMDL will be considered in *Kansas Water Plan* implementation decisions under the State Water Planning Process for Fiscal Years 2003-2007.

8/4/04