

# CIMARRON RIVER BASIN TOTAL MAXIMUM DAILY LOAD

**Waterbody: Crooked Creek**  
**Water Quality Impairment: Chloride**

## 1. INTRODUCTION AND PROBLEM IDENTIFICATION

**Subbasin:** Crooked

**Counties:** Meade, Ford, Gray, Grant, Haskell,  
Seward, and Haskell

**HUC 8:** 11040007

**HUC 11s (HUC 14s):** **010** (010, 020, 040, 050, 060, 070, 080)  
**020** (010, 020, 030, 040, 050)  
**030** (010, 020, 030, 040, 050, 060)  
**040** (010, 020, 030)  
**050** (010, 020, 040, 050, 060, 070, 080)

**Drainage Area:** 587 square miles

**Main Stem Segments:** 1 and 2; starting at state line and traveling upstream to Copeland  
(**Figure 1**)

**Tributary Segments:** Unnamed Stream (1180) *unimpaired*  
Unnamed Stream (1253) *unimpaired*  
Unnamed Stream (1259) *unimpaired*  
Stumpie Arroyo (1247)  
Spring Creek (3)  
Remuda Creek (4)

**Designated Uses:** Expected Aquatic Life Support on Main Stem ( 2) and Remuda Creek (4); Special Aquatic Life on Main Stem (1) and (3 and 1247); Primary Contact Recreation on Spring Creek (3); Secondary Contact Recreation on Main Stem (1 and 2) and (1247); Domestic Water Supply; Food Procurement; Ground Water Recharge; Industrial Water Supply Use; Irrigation Use; Livestock Watering Use on Main Stem (1 and 2) and (3).

**1998 303(d) Listing:** Table 1 - Predominant Non-point Source and Point Source Impacts (Main Stem, Segment 2)  
Table 3 - Predominantly Natural Conditions (Main Stem, Segment 1 and tributary segments)

**Impaired Use:** Domestic Water Supply

**Water Quality Standard:** 250 mg/L for Domestic Water Supply (KAR 28-16-28e(c)(3)(A))  
352 mg/l for Aquatic Life Support (K.A.R. 28-16-28e(c)(2)(F)(i))

In stream segments where background concentrations of naturally occurring substances, including chlorides and sulfates, exceed the water quality criteria listed in Table 1a of KAR 28-16-28e(d), at ambient flow, the existing water quality shall be maintained, and the newly established numeric criteria shall be the background concentration, as defined in KAR 28-16-28b(e). Background concentrations shall be established using the methods outlined in the “Kansas implementation procedures: surface water,” dated June 1, 1999... (KAR 28-16-28e(b)(9)).

# Crooked Creek TMDL Reference Map

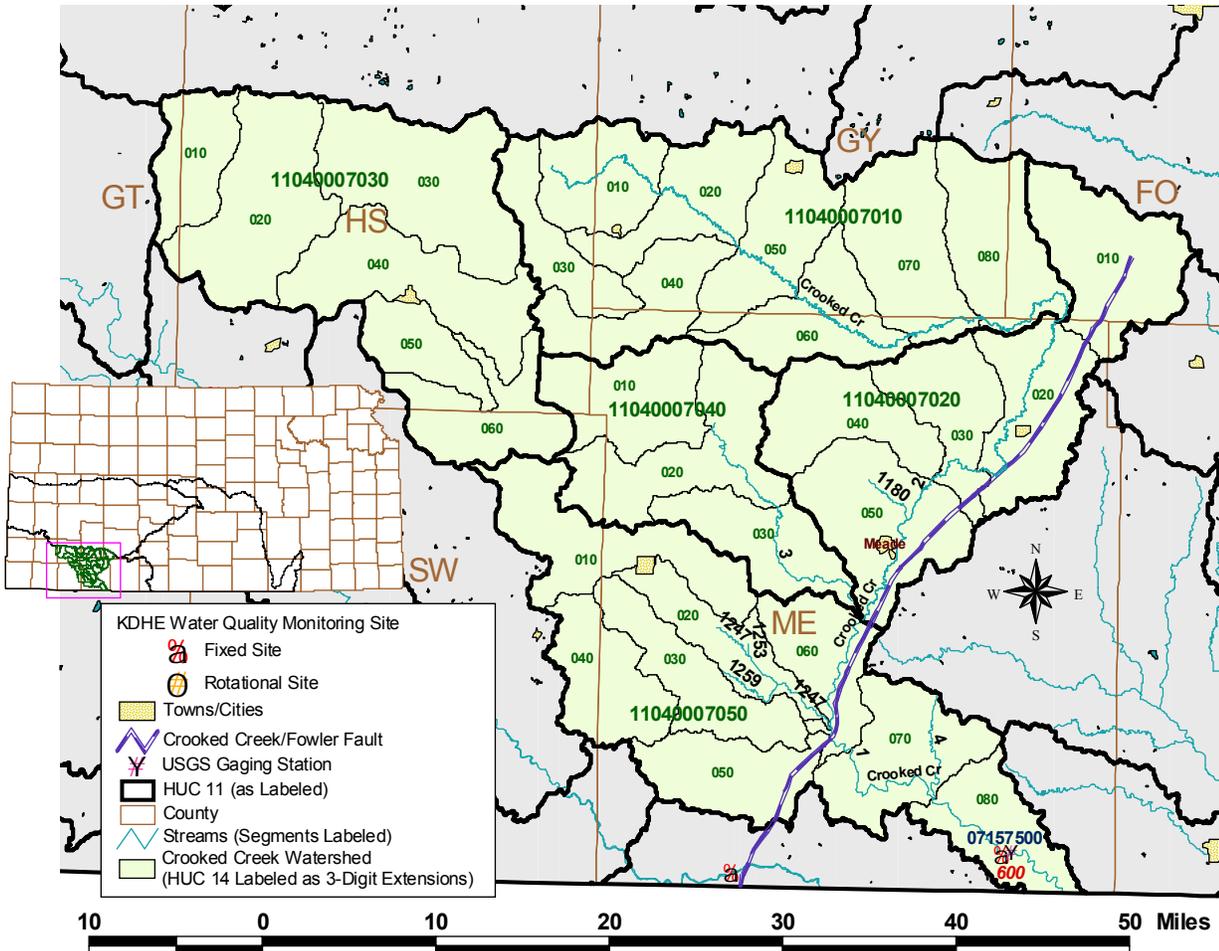


Figure 1

## 2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

**Level of Support for Designated Use under 1998 303(d):** Not Supporting Domestic Water Supply

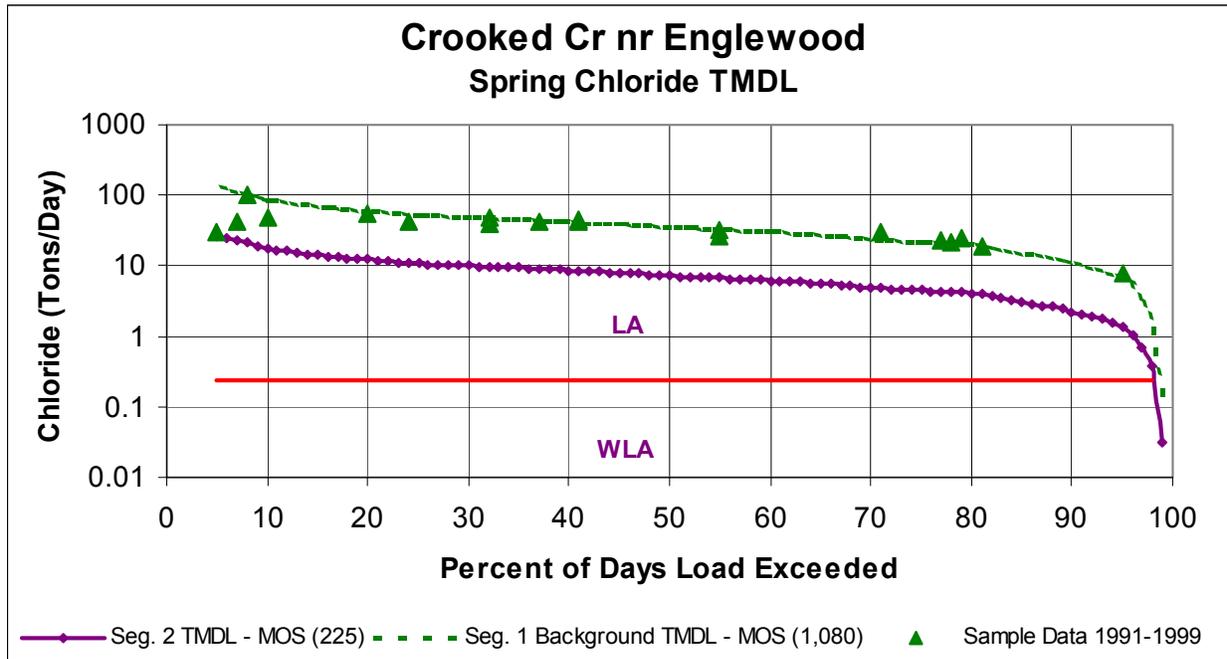
**Monitoring Sites:** Station 600 near Englewood (**Figure 1**)

**Period of Record Used:** 1991 to 1999

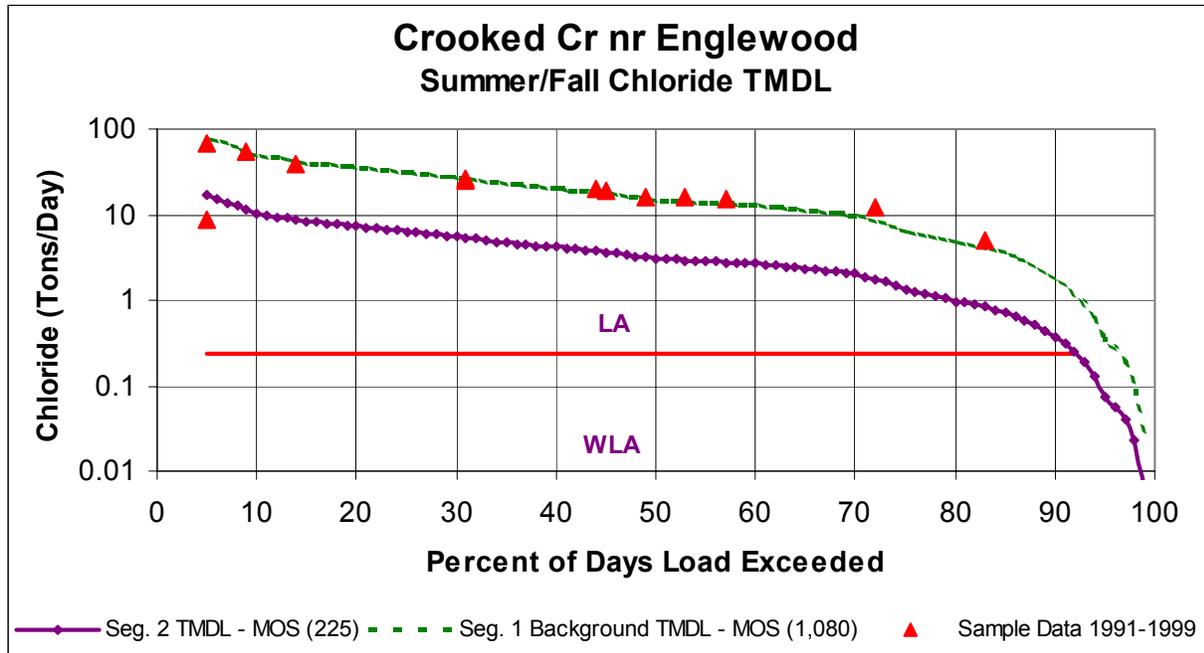
**Flow Record:** Crooked Creek near Englewood (USGS Station 07157500); 1975 - 1999

**Long Term Flow Conditions:** Median Flow = 10 cfs, 7Q10 = 1 cfs

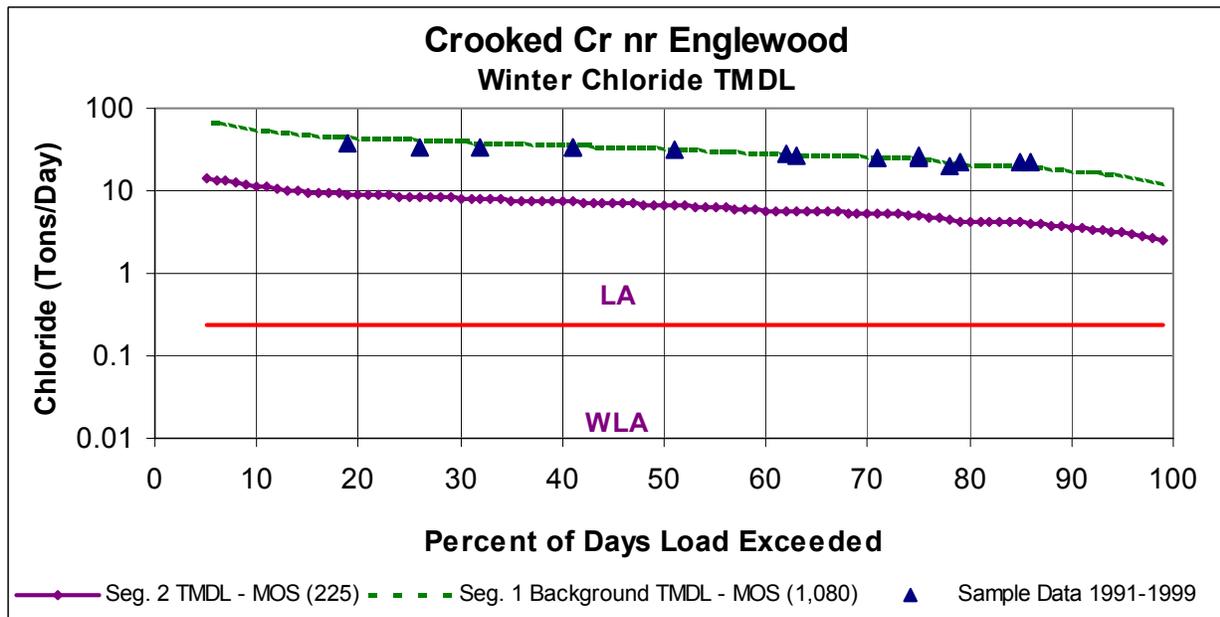
**Current Conditions:** Since loading capacity varies as a function of the flow present in the stream, this TMDL represents a continuum of desired loads over all flow conditions, rather than fixed at a single value. Flow duration data were examined from the Englewood Gaging Station for each of the three defined seasons: Spring (Mar-Jul), Summer-Fall (Aug-Oct) and Winter (Nov-Feb). 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 chloride 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 of chloride per day. These load curves represent the TMDL since any point along the curve represents water quality at the standard at that flow. Historic excursions from WQS are seen as plotted points above the load curves. Water quality standards are met for those points plotting below the applicable load duration curves (**Figures 2, 3 and 4**).



**Figure 2**



**Figure 3**



**Figure 4**

Excursions were seen in all three seasons. Ninety five percent of Spring samples from water quality site 600 were over the criteria. 93% of Summer-Fall samples and 100% of the Winter were over the criterion. This would represent a baseline condition of non-support of the impaired designated use for both sites.

**NUMBER OF SAMPLES OVER CHLORIDE STANDARD OF 250 MG/L BY FLOW AND SEASON**

Station	Season	0 to 10%	10 to 25%	25 to 50%	50 to 75%	75 to 90%	90 to 100%	Cum Freq.
Englewood (600)	Spring	3	2	5	3	4	1	18/19 = 95%
	Summer	2	1	6	3	1	0	13/14 = 93%
	Winter	0	1	4	4	6	0	15/15 = 100%

**Desired Endpoints of Water Quality (Implied Load Capacity) at Site 600 over 2005 - 2009:**

The ultimate endpoint for this TMDL will be to achieve the Kansas Water Quality Standards fully supporting Drinking Water Use. This TMDL will, however, be phased. The current standard of 250 mg/L of chloride was used to establish a load duration TMDL curve. Crooked Creek has two distinct conditions on its two segments. The lower Segment One lies below the Crooked Creek-Fowler Fault and is subject to mineral intrusion from upwelling groundwater from the Permian Formation. As such, the segment has highly elevated chloride levels from this natural source. This natural background of chloride, estimated to be considerably above 250 mg/L, makes achievement of the Standard impossible for Segment One.

Kansas Implementation Procedures for Surface Water allow for a numerical criterion based on natural background to be established using the mean concentration of in stream measurements gathered when stream flow was less than the median flow on the creek. A minimum of five data points is needed to determine the background concentration. The specific stream criteria to supplant the general standard will be developed concurrent with Phase One of this TMDL following the appropriate administrative and technical Water Quality Standards processes. Meanwhile, a Phase One endpoint has been developed for Segment One based on currently available information and is 1,200 mg/L from data collected over 1990-1999 at flows equal to or less than 10 cfs. The Phase Two TMDL will be based on the future standard. The Segment Two lies above the fault line and there is presently no evidence to indicate mineral intrusion is occurring throughout its length. Therefore, the 250 mg/L criterion will be the applied endpoint for this segment.

Seasonal variation has been incorporated in this TMDL through the documentation of the seasonal consistency of elevated chloride levels. 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 has been restored.

### 3. SOURCE INVENTORY AND ASSESSMENT

Groundwater contributing geologic formations underlying the Crooked Creek watershed have a naturally high level of chloride. The predominant source of chloride in the surface water can be attributed to this contribution to baseflow. Additionally, with the decline in the Ogallala aquifer comes a reduction in its relatively freshwater contribution to baseflow. This increases the proportion of baseflow contributed from the Permian system, which further increases the chloride concentration at downstream locations.

Some additional loading might be associated with winter road treatments, household-level water softening, and brine from oil fields and faults in the area. Additional monitoring will be required to determine the relative contribution of these sources.

### 4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

Additional assessment will be necessary to ascertain the amount of natural chloride loading within the watershed relative to anthropogenic sources. The following can be anticipated:

**Point Sources:** There is one point source above the monitoring location; Meade, which is located on Stream Segment 2. Additional chloride data is needed on Crooked Creek immediately upstream and downstream of the City of Meade NPDES site to determine the city's relative contribution to the chloride load. Tentatively, the Wasteload Allocation on Stream Segment 2 shall be 470 pounds per day of chloride (based on design flow of 0.387 cfs) at the 7Q10 of 1 cfs. This allocation may increase should additional sampling indicate elevated chloride levels upstream of the city. Consideration should also be given to the location of Meade on Segment 2. The effluent of Meade enters the lowest portion of the segment before it crosses the fault line demarcating Segments 1 and 2 and the creek incurs mineral intrusion. Therefore the effluent of Meade has limited impact to Segment 2 and more impact in Segment 1. Using an elevated background concentration of 500 mg/l, the Meade Wasteload Allocation would be 1,045 pounds per day.

**Non-Point Sources:** The majority of the chloride load is likely natural background along the creek. Assuming no intrusion on Segment 2, the Load Allocation will be 1,215 pounds per day of chloride at the 7Q10. This allocation increases on Stream Segment 1 to 5,832 pounds per day at the 7Q10 if the elevated background concentrations become the applicable criteria. The allocation also increases as a function of flows above the 7Q10 of 1 cfs.

**Defined Margin of Safety:** The Margin of Safety will be ten percent of the applicable chloride load, or 187 pounds per day at 7Q10 on Segments 1 and 2. Again, the Margin of Safety increases to 648 pounds per day at 7Q10 if the elevated background concentration becomes the applicable criteria.

**State Water Plan Implementation Priority:** Because it presently appears this watershed's chloride load is predominately natural in source this TMDL will be a Low Priority for implementation.

**Unified Watershed Assessment Priority Ranking:** This watershed lies within the Crooked Subbasin (HUC 8: 11040007) with a priority ranking of 29 (Medium Priority for restoration work).

**Priority HUC 11s and Stream Segments:** Pending additional monitoring and assessment, no priority subwatersheds or stream segments should be identified until after 2005.

## **5. IMPLEMENTATION**

### **Desired Implementation Activities**

1. Renew necessary state and federal permits and monitor permitted facilities for permit compliance with appropriate effluent limits
2. Establish appropriate background concentrations and confirm designated uses

### **Implementation Programs Guidance**

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

- a. Municipal and industrial permits for facilities along river will be renewed in 2002 with appropriate chloride effluent limits reflecting background concentrations.

#### **Water Quality Standards and Assessment - KDHE**

- a. Confirm designated uses of domestic water supply and livestock watering on stream reaches
- b. Establish background levels of chloride for Crooked Creek.

**Timeframe for Implementation:** Development of a background level- based water quality standard should be accomplished with the 2002 water quality standards.

**Targeted Participants:** Primary participants for implementation will be KDHE and permitted facilities at Meade.

**Milestone for 2005:** The year 2005 marks the mid-point of the ten year implementation window for the watershed. At that point in time, additional monitoring data from Station 600 and other sites of significance on Crooked Creek will be re-examined to confirm the impaired status of the river and the suggested background concentration. In light of this additional data, 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. 65-164 and 165 empowers the Secretary of KDHE to regulate the discharge of sewage into the waters of the state.
2. 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.
3. K.S.A. 82a-706. Empowers the chief engineer of the Division of Water Resources, KDA, to enforce and administer the laws of this state pertaining to the beneficial use of water and shall control, conserve, regulate, allot and aid in the distribution of the water resources of the state for the benefits and beneficial uses of all of its inhabitants in accordance with the rights of priority of appropriation.
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 Cimarron 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 TMDL is a Low Priority consideration and should not receive funding.

**Effectiveness:** Improvements in reducing chloride loading to streams can be accomplished through appropriated management of winter road treatments and household water softeners. Minimal control can be exerted on natural contributions to loading.

## 6. MONITORING

KDHE will continue to collect bimonthly samples at Station 600, including chloride samples over each of the three defined seasons. Additional data collection should occur on Crooked Creek above and below the City of Meade to determine the relative contribution by the City. Based on that sampling, the status of 303(d) listing will be evaluated in 2006 including application of a numeric criteria based on background concentrations. 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 2005-2009.

## 7. FEEDBACK

**Public Meetings:** Public meetings to discuss TMDLs in the Cimarron Basin were held March 8 and April 25 in Meade. 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 Cimarron Basin.

**Public Hearing:** A Public Hearing on the TMDLs of the Cimarron Basin was held in Meade on May 30, 2000.

**Basin Advisory Committee:** The Cimarron Basin Advisory Committee met to discuss the TMDLs in the basin on October 6, 1999; January 12, 2000; March 8, 2000.

**Discussion with Interest Groups:** Meetings to discuss TMDLs with interest groups include:  
Agriculture: February 28, 2000

**Milestone Evaluation:** In 2005, evaluation will be made as to the degree of impairment which has occurred within the watershed and current condition of the listed stream segments. Subsequent decisions will be made regarding implementation approach and follow up on additional implementation in subwatersheds.

**Consideration for 303(d) Delisting:** This watershed will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2005-2009. Therefore, the decision for delisting will come about in the preparation of the 2006 303(d) list. Should modifications be made to applicable criterion 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 2002 which 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 after Fiscal Year 2005.

Approved September 11, 2000