



# Bluff Creek TMDL Reference Map

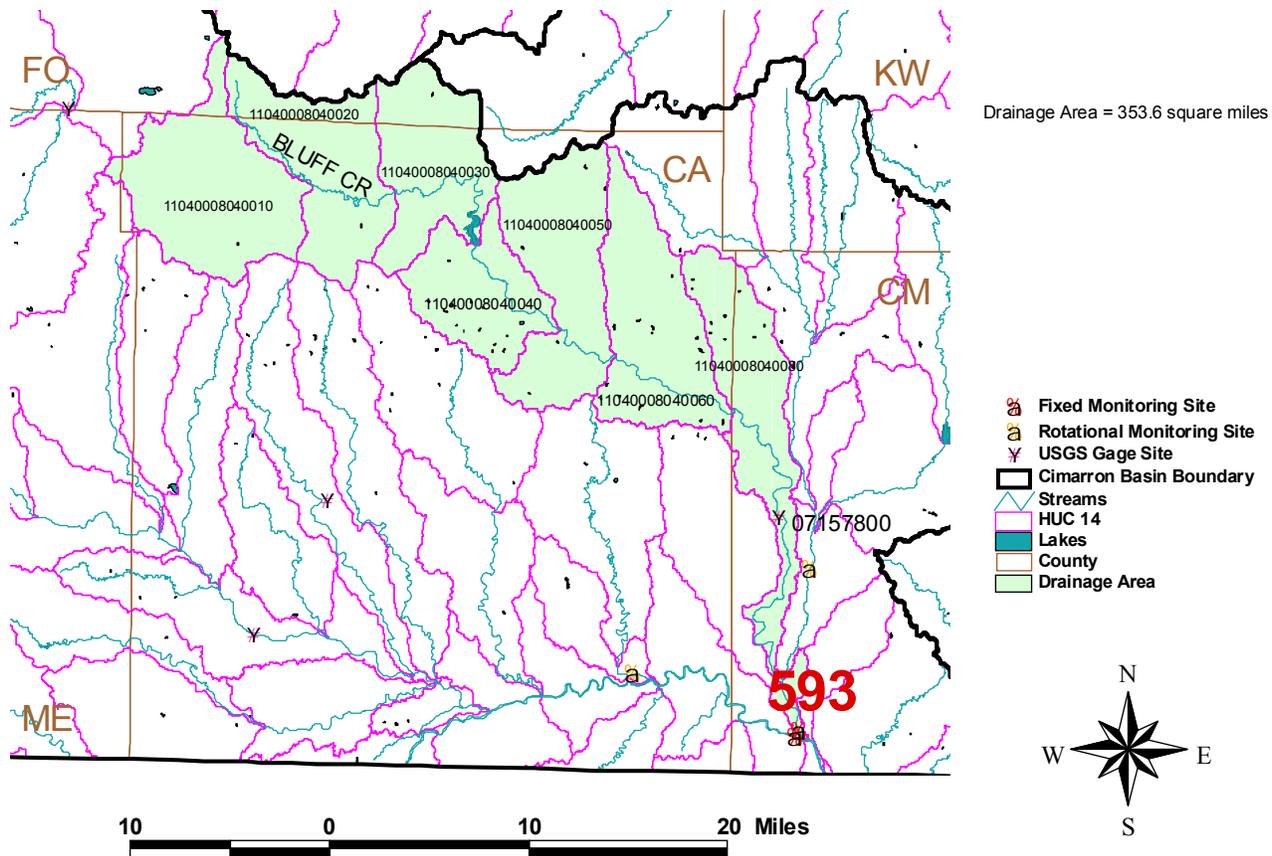


Figure 1

## 2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

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

**Monitoring Site:** Station 593 near Protection

**Period of Record Used:** 1990 to 2000

**Flow Record:** Bluff Creek flow conditions were estimated by using actual flow data for the Crooked Creek near Englewood (USGS Station 07157500; 1975 - 1999)

**Long Term Flow Conditions:** Median Flow = 10 cfs, 7Q10 = 1 cfs at Crooked Creek near Englewood

**Current Conditions:** Sulfate concentrations have ranged from 65.3 mg/l to 727.0 mg/l over the period of record. Using flow conditions at Englewood as a guide the average baseflow concentration was determined to be 353.4 mg/L. This would represent a natural background concentration for the Bluff Creek. Excursions were seen in all three seasons. Fifty-seven percent of samples from water quality site 593 were over the criterion of 250 mg/l.

**Desired Endpoints of Water Quality (Implied Load Capacity) at Site 593 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 sulfate was used to establish the TMDL however, the Bluff Creek is subject to mineral intrusion from upwelling groundwater from the Permian Formation. As such, the segment has highly elevated sulfate levels from this natural source. This natural background of sulfate, estimated to be considerably above 250 mg/L, makes achievement of the Standard impossible.

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 based on currently available information and is 350 mg/L from data collected over 1990-2000 at flows equal to or less than median. The Phase Two TMDL will be based on the future standard.

Seasonal variation has been incorporated in this TMDL through the documentation of the seasonal consistency of elevated sulfate 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**

The Upper Cimarron River –Bluff Subbasin is located primarily in Clark County, eastern Meade County, and western Comanche County. The Cimarron River in the subbasin receives groundwater discharge from alluvium underlain primarily by Permian bedrock between the KDHE monitoring station 222 north of Forgan, OK and station 592 south of Protection, KS. It also receives flow from tributaries, for example, Bluff Creek, to which ground water discharges from alluvium underlain mainly by Permian bedrock. The Permian bedrock in Meade, Clark, and Comanche counties, Kansas and northern Beaver and Harper counties, Oklahoma contains substantial thicknesses of the evaporite minerals halite or rock salt (NaCl), anhydrite, (CaSO<sub>4</sub>), and gypsum (CaSO<sub>4</sub> · 2H<sub>2</sub>O) in the subsurface. The source of the high sulfate and chloride

concentrations in the Cimarron River south of Protection and its tributaries within the Upper Cimarron – Bluff Subbasin is natural dissolution of the evaporite minerals in the bedrock. The Permian saltwater high in chloride and sulfate or mineralized water high in sulfate discharges from the bedrock into the overlying alluvial aquifers of the river and its tributaries and then into the river. High flows of the river include greater amounts of water flowing over or within soils and from shallow bedrock from which most of the evaporites have been dissolved. The higher flows are fresher than the bedrock discharge and thus, the chloride and sulfate concentrations are lower than during low flows that are substantially affected by the Permian saltwater or mineralized water intrusion.

For higher to moderate flows in Bluff Creek near Protection the sulfate concentration increases at a greater rate than the chloride content. The higher to moderate flows reflect waters that pass through soils, the alluvium, and shallow bedrock. The primary evaporite mineral in the shallow bedrock is gypsum because the more soluble halite has been removed by dissolution and the anhydrite has been hydrated during long-term flow of deeper ground waters. Therefore, the salinity source for higher to moderate flows is mainly gypsum. The lower flows in the river and the tributaries are affected more by discharge of deeper, more saline ground water that contains high contents of both chloride and sulfate. The Bluff Creek samples with higher chloride concentrations reflect the greater impact of intrusion of deeper saltwater.

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

Additional sampling and assessment will be necessary to ascertain the amount of natural background sulfate loading within the watershed.

**Point Sources:** A Wasteload Allocation of zero will be established by this TMDL because of the lack of point sources along the segment. Should future point sources be proposed in the watershed and discharge into the impaired segments, the current wasteload allocation will be revised by adjusting current load allocations to account for the presence and impact of these new point source dischargers.

**Non-Point Sources:** Elevated sulfate concentrations appear to be a natural feature of the river. Nonetheless, no external sources or loads should discharge into the river, thereby increasing the sulfate concentration. Therefore, the Load Allocation of sulfate contributing substances will be set to reduce the long term average sulfate on the river below 350 mg/L at baseflow.

**Defined Margin of Safety:** The margin of safety provides some hedge against the uncertainty of loading and the chloride endpoint. The current margin of safety is implicit because of the conservative assumption that zero allocations are assigned to anthropogenic sources, ie, the current loading is natural. However, in the future, the margin of safety will be used to reduce any proposed future wasteload allocations by 10%.

**State Water Plan Implementation Priority:** Because it presently appears that the sulfate load is natural in source, this TMDL will be a Low Priority for implementation.

**Unified Watershed Assessment Priority Ranking:** This watershed lies within the Upper Cimarron–Bluff Subbasin (HUC 8: 11040008) with a priority ranking of 52 ( Low Priority for restoration).

**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. Establish appropriate background concentrations and confirm designated uses

### **Implementation Programs Guidance**

#### **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 sulfate for Bluff 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 .

**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 593 and other sites of significance on Bluff 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. 65-171d 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. 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.

3. 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.

4. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the *Kansas Water Plan*.

5. 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:** Minimal control can be exerted on natural contributions to loading.

## 6. MONITORING

KDHE will continue to collect bimonthly samples at Station 593, including sulfate samples over each of the three defined seasons. Based on that sampling, the status of 303(d) listing will be evaluated in 2006 including application of a numeric criterion based on background concentrations. Should the 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 the 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.

## References

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- Merriam, D.F., 1963, The geologic history of Kansas, Kansas Geological Survey, Bulletin 162, 317 p.
- Swineford, A., 1955, Composition and texture of Upper Permian sediments in south-central Kansas: *in*, Southwest Kansas, Kansas Geological Society, Eighteenth Annual Field Conference, p. 57-59.
- Swineford, A., 1955, Petrography of Upper Permian rocks in south-central Kansas: Kansas Geological Survey, Bulletin 111, 179 p.

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