

LOWER ARKANSAS RIVER BASIN TOTAL MAXIMUM DAILY LOAD

Waterbody: Mule Creek
Water Quality Impairment: Sulfate

1. INTRODUCTION AND PROBLEM IDENTIFICATION

Subbasin: Upper Salt Fork Arkansas **Counties:** Barber, Comanche, and Kiowa

HUC 8: 11060002

HUC 11 (HUC 14s): **010** (010, 020, 030, 040, and 050)

Drainage Area: 205.6 mi

Main Stem Segment: WQLS: 7; starting at the confluence with the Salt Fork Arkansas River; Headwaters in South-Central Kiowa County.

Designated Uses: Special Aquatic Life Support; Primary Contact Recreation; Domestic Water Supply; Food Procurement; Ground Water Recharge; Industrial Water Supply Use; Irrigation Use; Livestock Watering Use for Main Stem Segment

1998 303(d) Listing: Table 1 - Predominant Point and Non-point Source Impacts

Impaired Use: Domestic Water Supply

Water Quality Standard: 250 mg/l for Domestic Water Supply (KAR 28-16-28e(c)(3)(A))

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)).

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 622 near Aetna

Period of Record Used: 1992, 1996 and 1999 (Kansas Biological Survey samples in 1999)

Flow Record: Mule Cr near Wilmore, USGS Station 07148200; calculated flow based on measurements at 07148200 and data from Station 07149000 (Medicine Lodge River near Kiowa)

Long Term Flow Conditions: Median Flow = 9.5 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. An overall Flow duration curve was developed for the Creek. 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 sulfate 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 sulfate per day. These load curves represent the TMDL since any point along the curve represents water quality 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.

Excursions were seen at all times of the year. Sixty four percent of the samples from water quality site 622 were over the criteria. This would represent a baseline condition of non- support of the designated uses for the site. Overall, the average concentration of the 14 samples was 311 mg/l. Average concentrations prior to April 1996 were 233 mg/l, while averages thereafter were 389 mg/l. Average percent flow exceedence of samples taken prior to April 1996 was 59%, while subsequent samples were taken at higher flows, averaging 37% exceedence. Concentrations taken at flows below median flow averaged 288 mg/l, those taken at higher flows averaged 352 mg/l.

NUMBER OF SAMPLES OVER SULFATE STANDARD OF 250mg/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.
Mule Cr nr Wilmore (622)	Annual	2	2	0	2	2	1	9/14 = 64%

Desired Endpoints of Water Quality (Implied Load Capacity) at Site 622 over 2005 - 2010:

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 a load duration curved on the TMDL curve.

Kansas Implementation Procedures for Surface Water allow for a numerical criterion based on natural background to be established using the mean concentration of at least five in-stream measurements gathered when stream flow was less than the median flow on the creek. However, the nature of geologic contributions causes higher sulfate levels at flows higher than the median flow. Regardless, the specific stream criteria to supplant the usual standard will be developed concurrent with Phase One of this TMDL following the appropriate administrative and technical Water Quality Standards processes. Meanwhile, a Phase Two endpoint has been developed for the creek based on currently available information and is recommended to be 310 mg/L based on the overall average of data collected over 1992, 1996 and 1999 across the range of flows seen on the creek. The Phase Two endpoint would reduce the number of excursions from nine to five.

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

Bedrock outcropping and underlying alluvial sediments of the Mule Creek watershed within the subbasin of the Upper Salt Fork of the Arkansas River in Comanche County and westernmost Barber County consists primarily of shales, siltstones, and sandstones of the Permian System. These include strata in the Upper Permian and upper part of the Lower Permian Series, including the Dog Creek Shale, Blaine Formation, and Flowerpot Shale, all of which contain gypsum beds or veins. The Blaine Formation contains gypsum beds of substantial thickness. The prevalence of gypsum at or near the land surface in the watershed of Mule Creek contributes substantial amounts of sulfate to runoff and ground-water discharge to streams as a result of natural dissolution of the mineral. The sulfate concentration ranges from 237 to 437 mg/L while the range in chloride content is 19-30 mg/L. The high sulfate/chloride ratio and the prevalence of gypsum in the bedrock fit the natural dissolution as the predominant source of mineralized water in the river.

Oil-field brines have very low sulfate/chloride ratios in Kansas and could not be a significant source of sulfate based on the water chemistry of Mule Creek. There is little irrigation in the watershed due to the prevalence of bedrock at or near the surface and the thin saturated thickness of unconsolidated sediments that are present. Therefore, there is very little effect on the sulfate content of the creek water that could be attributed to irrigation.

Contributing Runoff: The watershed's average soil permeability is 2.9 inches/hour according to NRCS STATSGO data base. About 54% of the watershed produces runoff even under relative low (1.5"/hr) potential runoff conditions. Under very low (<1"/hr) potential conditions, this potential contributing area is more than halved (21%). Runoff is chiefly generated as infiltration excess with rainfall intensities greater than soil permeabilities. As the watersheds' soil profiles become saturated, excess overland flow is produced. Generally, storms producing less than 0.5"/hr of rain will generate runoff from only 4% of this watershed, chiefly along the stream channels.

4. ALLOCATION OF POLLUTION REDUCTION RESPONSIBILITY

Point Sources: A Wasteload Allocation of zero will be established by this TMDL because of the lack of point sources in the watershed. 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: This sulfate load is background geologic in nature. The Load Allocation based on the existing standard will be 1,215 pounds per day at one cfs and 11,540 pounds per day at the median flow. This allocation increases to 1,500 pounds per day at one cfs and 14,310 pounds per day at median flow if the elevated background concentration becomes the applicable criteria. The Load Allocation is intended to reduce the number of excursions over the applicable water quality criterion.

Defined Margin of Safety: The Margin of Safety provides some hedge against the uncertainty of loading and the sulfate endpoint and will be ten percent of the applicable sulfate load, or 135 pounds per day at one cfs and 1280 pounds per day at median flow. Again, the Margin of Safety increases to 167 pounds per day at one cfs and 1590 pounds per day if the elevated background concentration becomes the applicable criteria.

State Water Plan Implementation Priority: Because it appears this watershed's 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 Salt Fork Arkansas River Subbasin (HUC 8: 11060004) with a priority ranking of 47 (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. Monitor any anthropogenic contributions of sulfate loading to river.
2. Establish alternative background criterion
3. Assess likelihood of creek being used for domestic uses.

Implementation Programs Guidance

Non-Point Source Pollution Technical Assistance - KDHE

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

Water Quality Standards and Assessment - KDHE

- a. Establish background levels of sulfate for Mule Creek and recommend an alternative water quality criterion.

Use Attainability Analysis - KDHE

- a. Consult with Division of Water Resources on locating existing or future domestic points of diversion on Mule Creek for drinking water purposes.

Timeframe for Implementation: Continued monitoring over the years 2000, 2004 and 2008. Development of a background level-based water quality criterion should be accomplished with the 2005 water quality standards revision.

Targeted Participants: Primary participants anticipated with this TMDL will be KDHE.

Milestone for 2006: The year 2006 marks the mid-point of the ten year implementation window for the watershed. At that point in time, additional monitoring data from Station 622 and assessments will be examined to confirm the impaired status of the river, evaluate the alternative background concentration criterion and determine the presence of any anthropogenic loading to the creek. The percent of samples over the applicable criterion should decrease from the percentage seen prior to 2000. Should the case of impairment remain, allocation and implementation activities will ensue.

Delivery Agents: Depending upon confirmation of impairment and assessment of probable sources, the primary delivery agents for program participation will be the programs of the Kansas Department of Health and Environment and the Kansas Department of Agriculture, Division of Water Resources.

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.A.R. 28-16-69 to -71 implements water quality protection by KDHE through the establishment and administration of critical water quality management areas on a watershed basis.
4. 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.
5. 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.
6. K.S.A. 82a-951 creates the State Water Plan Fund to finance the implementation of the *Kansas Water Plan*.
7. The *Kansas Water Plan* and the Lower Arkansas River 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 during 2000, 2004 and 2008 at rotational Station 622, including sulfate samples over each of the three defined seasons. Based on that sampling, the status of 303(d) listing will be evaluated in 2010 including application of a numeric criteria based on background concentrations and impairment definition reflecting natural conditions. 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 after 2010.

7. FEEDBACK

Public Meetings: Public meetings to discuss TMDLs in the Lower Arkansas River Basin were held March 9, 2000 and April 26-27, in Hutchinson, Wichita, Arkansas City and Medicine Lodge. 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 Lower Arkansas River Basin. A draft of this TMDL has been maintained on the website since June 1, 2000 and modifications to the original draft have been available to the public for viewing and review up to the date of submitting this TMDL to EPA.

Public Hearing: A Public Hearing on the original draft of these TMDLs of the Lower Arkansas River Basin was held in Wichita on June 1, 2000.

Basin Advisory Committee: The Lower Arkansas River Basin Advisory Committee met to discuss the TMDLs in the basin on September 27, and November 8, 1999; January 13 and March 9, 2000. The Committee recommended approval of the Basin Plan which set high priority TMDLs in the basin, thereby, delegating medium and low priority status to this and subsequent TMDLs for the basin. The Kansas Water Authority approved the Basin Plan on July 11, 2000.

Discussion with Interest Groups: Meetings to discuss TMDLs with interest groups include:
Sedgwick County Technical Advisory Group: August 8, October 14, November 15, 1999 and January 20, 2000.
Agriculture: January 12, February 2 and 19, 2000.
Environmental: March 9, 2000.
Conservation Districts: November 22, 1999.
Industry: December 15, 1999, January 13, February 9 and 22, 2000.
Local Environmental Protection Groups: September 30, November 2, December 16, 1999.

Milestone Evaluation: In 2006, 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: Mule Creek will be evaluated for delisting under Section 303(d), based on the monitoring data over the period 2000-2008. Therefore, the decision for delisting will come about in the preparation of the 2010 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 July 27, 2001