

# UPPER ARKANSAS BASIN TOTAL MAXIMUM DAILY LOAD

## Waterbody: Arkansas River from Larned to Great Bend Water Quality Impairment: Sulfate

### 1. INTRODUCTION AND PROBLEM IDENTIFICATION

**Subbasin:** Arkansas-Pickle

**Counties:** Pawnee and Barton

**HUC 8's:**11030004

**HUC 11s:** Not Applicable

**Drainage Area:** 354 miles<sup>2</sup> between Great Bend and Larned

**Main Stem Segments:** 1,2, 4, & 5 in 11030004 (Figure 1)

**Tributary Segments:** None

**Designated Uses:** All uses including Special Aquatic Life Support and Primary Contact Recreation

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

**Impaired Uses:** Domestic Water Supply, Livestock Watering and Groundwater Recharge

**Water Quality Standards:** 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: 1000 mg/l (Table 1a of K.A.R. 28-16-28e(d));

In stream segments where background concentrations of naturally occurring substances, including chlorides, sulfates and selenium, 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(f). (KAR 28-16-28e(b)(9)).

In surface waters designated for the groundwater recharge use, water quality shall be such that, at a minimum, degradation of ground water quality does not occur. Degradation shall include any statistically significant increase in the concentration of any chemical contaminant in ground water resulting from surface water infiltration or injection. (K.A.R. 28-16-28e(c) (5)).

# Arkansas River near Great Bend TMDL Reference Map

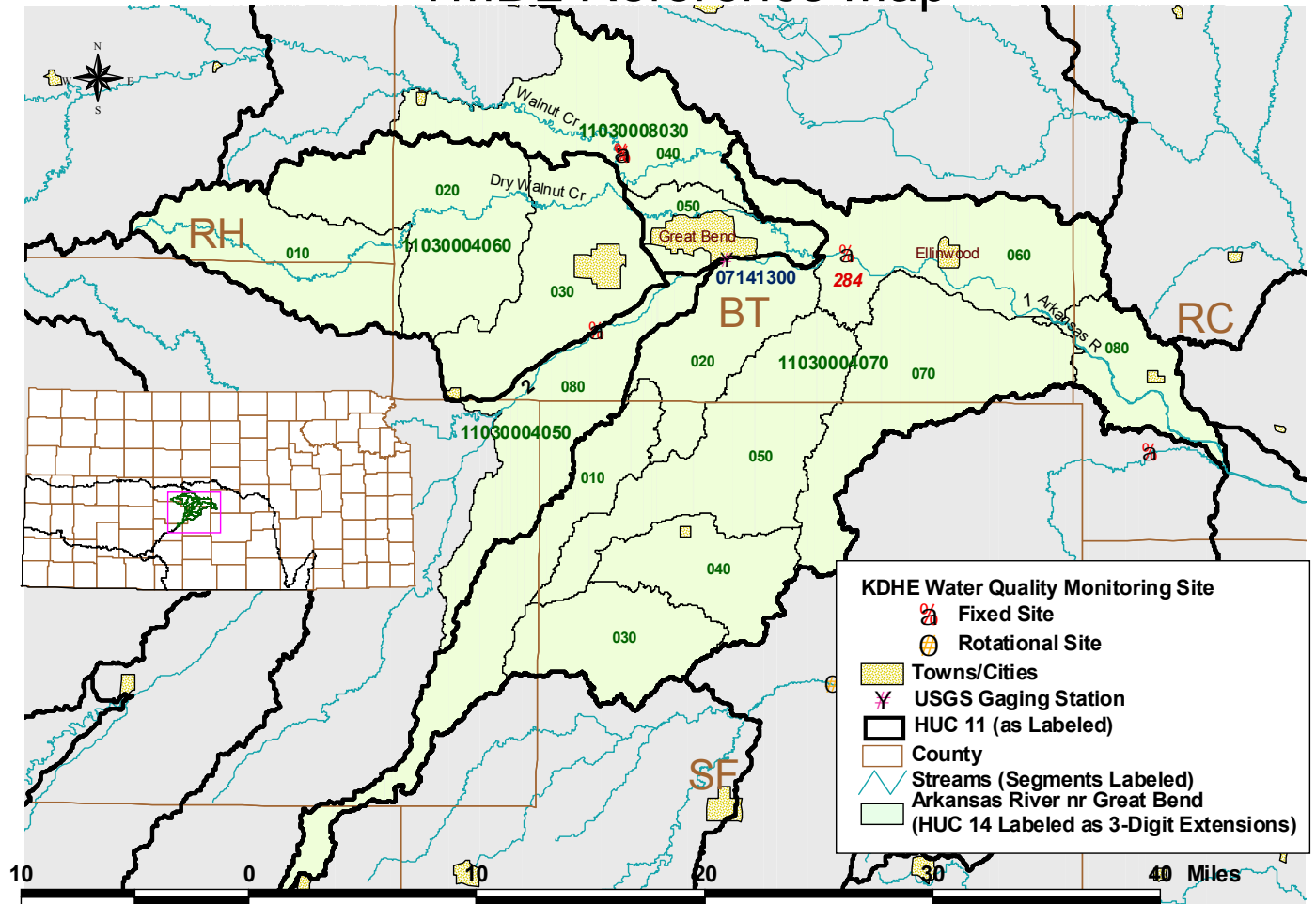


Figure 1

## 2. CURRENT WATER QUALITY CONDITION AND DESIRED ENDPOINT

**Level of Support for Designated Use under 1998 303d:** Not Supporting Domestic Water Supply or Livestock Watering

**Monitoring Sites:** Station 584 near Dundee and 284 below Great Bend

**Period of Record Used:** 1987--1999

**Flow Record:** (USGS Station on Arkansas River at Great Bend (07141300) ;Recorded daily data 1970 - 1999)

**Long Term Flow Conditions:** Average Flow from 1970-1999 at Great Bend, 152 cfs; Median flow, 20 cfs

**Current Conditions:** Sulfate concentrations average 745 mg/l near Dundee over 1987-1999. Some dilution is seen downstream with average of 505 mg/l at Great Bend. During the period 1990 to mid-1996 averages were 194 mg/l at Dundee and 217 mg/l at Great Bend indicating the lack of flow entering these reaches from the Dodge City area and the interaction of freshwater from the Big Bend Prairie aquifer in Pawnee and Barton counties. After October 1996, with the resumption of flow past Dodge City (Figure 2), intrusion of sulfate in these reaches is noted with averages at Dundee and Great Bend rising to 1192 mg/l and 986 mg/l, respectively. The five-fold increase is driven by the flow from western Kansas moving past historic losing reaches in Gray and Ford counties and increasing flow below Larned. Some dilution is still noted as freshwater from the surrounding Big Bend Prairie Aquifer moderates the sulfate levels somewhat. Nonetheless, sulfate levels have remained elevated since the resumption of flow in July 1996 (Figure 3). Therefore, the predominant loading of sulfate arrives down the river from contributions in western Kansas and Colorado.

#### **Desired Endpoint Condition of Water Quality at Stations 584 and 284 over 2005 -2010**

While the ultimate goal of a TMDL is attainment of the applicable criteria associated with the water quality standards and designated uses of the segment in question; 250 mg/l in this case, the recent data taken over the range of flows indicate that such a goal may be unattainable while flow moves downstream from Western Kansas, as indicated by flow at Dodge City. Under low flow conditions when these reaches were disconnected from upstream reaches with perennial flow, ground water contributions to the river tended to dilute any sulfate inputs coming in above Larned. Achievement of the 250 mg/l standard was commonplace.

Once the river resumed flow through Finney, Gray and Ford counties, the sulfate levels rose five-fold. Until sulfate levels in the upper reaches are reduced, the likelihood of reaching the water quality standards along these river segments is remote. Therefore, the interim endpoint of this TMDL will be to reduce the long term average sulfate concentration below the current average of 1000 mg/l at Great Bend as long as the river flows past Dodge City (Figure 4). Attaining this reduction should reflect attempts to reduce sulfate levels in the upstream reaches and capitalizing on the historic dilution of levels in a downstream direction. Because of the groundwater influence on the river in this region, the sulfate concentrations are seen throughout the seasons, with slightly higher concentrations seen during winter as was experienced in the river reaches above Garden City.

Should low water availability conditions resurrect the losing reaches of the river in Gray and Ford counties, sulfate levels should return to their pre-1996 levels. Therefore, during periods when the river does not flow past Dodge City, as was commonplace from 1986-1996, the endpoint of this TMDL will be the 250 mg/l water quality standard at Great Bend.

### **3. SOURCE INVENTORY AND ASSESSMENT**

**NPDES:** There are no NPDES permitted wastewater facilities contributing sulfate to these stream reaches.

**Irrigation Return Flow:** As noted in the analysis of the current situation, large concentrations of sulfate enter the state at Coolidge and continue to be high at Pierceville. Loss of flow in Gray and Ford Counties allows the river to begin anew in eastern Ford County with low sulfate levels. Once the river resumes flow, particularly past Dodge City, the sulfate levels increase significantly. Surface water irrigation is non-existent along these stretches of the river, with ground water irrigation predominating agricultural production. As such, there is little to no irrigation return flow downstream from Larned. Some sulfate enters the river reach around Great Bend from the Walnut Creek watershed which represents a chiefly natural source. Any excessive excursions of sulfate emanate from sulfate entering these reaches from upstream.

**Background Levels:** Sulfate levels have been moderated by the interaction of freshwater in the Big Bend Prairie and the Arkansas River. Some natural sulfate levels are likely contributed in the downstream reach from the Walnut Creek system.

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

The nature of sulfate loading along the Arkansas River reflects decades of natural contributions aggravated by patterns of irrigation water use and reuse along the upstream reaches near the stateline. Resumption of flow around Dodge City has brought about a significant increase in sulfate seen at Dundee and Great Bend. Therefore, short term reduction in sulfate loads in this reach of river will be negligible. Improvement in sulfate levels above Garden City should result in gradual lowering of ambient concentrations of sulfate seen throughout these stream reaches. As such, widespread application of this TMDL and its desired endpoints is premature. Therefore, establishment of background levels is appropriate and allocations relative to point and non-point sources are to be made in light of those elevated levels and current contributions..

**Point Sources:** A Wasteload Allocation of zero will be established by this TMDL because of the lack of point sources along the river. Should future point sources be proposed along the river 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:** The primary cause of elevated sulfate throughout these stream reaches is the

sulfate level of flow in the Arkansas River flowing past Dodge City and reflects the sulfate levels of the river upstream where surface flow is an perennial event. The sulfate reflects a natural contribution from the geology and soils of the drainage area in the valley aggravated by the historic pattern of irrigation return flow along the river, a non-point source. The Load Allocation will be to reduce the sulfate content of flows over 65 cfs at Great Bend over the next ten years. This allocation will be marked as the plotting of subsequent sampled loads below the TMDL curve (Figure 4).

**Defined Margin of Safety:** The Margin of Safety is implicit based on the conservative assumption that any anthropogenic loading of sulfate along these stream reaches is estimated to be lower in concentration than the loads calculated under this TMDL reflecting the loads transported by flows originating in the western plains. At higher flows which coincide with the incidence of elevated sulfate, any point source impacts will be masked by upstream non-point and natural contributions. Additionally, the Margin of Safety will be set to protect the low flow regime of this segment against future loadings of sulfate causing violation of the 250 mg/l water quality standard. Therefore, the margin of safety will reflect favorable sulfate conditions when the Arkansas River does not flow at Dodge City which corresponds to a flow at Great Bend below 65 cfs under those conditions. Therefore, the margin of safety will maintain sulfate levels below 250 mg/l at low flow conditions, by withholding 10% of available wasteload allocations from future point sources.

**State Water Plan Implementation Priority:** This TMDL will be a Medium Priority for implementation because of the influence of upstream sulfate loading entering these stream reaches, the need to establish background levels reflecting the import of high ambient concentrations, the time needed to establish any sulfate improvements in the upstream reaches and the need to ascertain any additional sources along these reaches and within the immediate watershed which might contribute sulfate under conditions seen on the river prior to 1996.

**Unified Watershed Assessment Priority Ranking:** This watershed lies within the Arkansas - Pickle Subbasins (HUC 8: 11030004) with a priority ranking of 31 (Medium Priority for restoration work).

**Priority HUC 11s and Stream Segments:** Because the sulfate impairment is confined to the mainstem of the Arkansas River, priority will be given to Segment 1 which will reflect all potential contributions arriving from upstream, resulting in high sulfate levels seen below Great Bend.

## 5. IMPLEMENTATION

### Desired Implementation Activities

1. Evaluate any potential sources between Larned and Great Bend as to possibly raising sulfate levels in river above pre-1996 levels
2. Establish appropriate background concentrations and confirm designated uses
3. Evaluate improvement in sulfate levels resulting from long term irrigation return flow management above Garden City.

## **Implementation Programs Guidance**

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

- a. Evaluate any point sources releasing wastewater in and around these impacted reaches as to potential to contribute sulfate and degrading water quality below Great Bend.

### **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 Dundee and Great Bend monitoring sites

### **Water Quality Planning - KDHE**

- a. Collaborate with Colorado on comprehensive irrigation return flow management plan for reduction in sulfate and selenium loadings

### **Subbasin Water Management - Division of Water Resources**

- a. Evaluate stream-aquifer interactions and the fate of water at low flow conditions at Dodge City.

**Timeframe for Implementation:** Work on the upstream management of sulfate levels, including that crossing the stateline will commence over 2000-2005. Evaluation of impact of any sulfate control on downstream reaches should occur after 2005.

**Targeted Participants:** Primary participants for implementation will be KDHE. Otherwise, activity is deferred to that which has to occur along the river above Garden City.

**Milestone for 2004:** The year 2005 marks the mid-point of the ten year implementation window for the stream segments. At that point in time, some consideration of upstream water quality improvement on downstream reaches should be evaluated. Additionally, sampled data from Station 284 should indicate evidence of reduced sulfate levels at flow conditions relative to the conditions seen over 1987-1999.

**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 along the river 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. The Federal Safe Drinking Water Act empowers KDHE to develop Source Water Protection Assessments and Plans.
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-1803 creates the Water Conservation Projects Fund to be administered by the Kansas Water Office for water conservation and water use efficiency projects in the Upper Arkansas River Basin impacted by the Arkansas River Compact.
7. The *Kansas Water Plan* and the Upper Arkansas 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.
8. K.S.A. 82a-701, et seq. authorizes the Chief Engineer and the Division of Water Resources to administer water appropriations in the state, including prevention of waste and planning and practicing water conservation.

**Funding:** The Water Conservation Projects Fund receives a portion of the funds recovered through the litigation over the Arkansas River Compact. The Fund is to be used for projects involving efficiency improvements to canals, water use efficiency devices, tailwater systems of irrigation system efficiency upgrades, monitoring equipment, artificial recharge or water right purchase and maintenance of the Arkansas River channel.

Other protection or planning activities are incorporated within the Upper Arkansas Basin Plan of

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 a portion of the \$16-18 million available annually from the State Water Plan Fund to water quality and water conservation projects and programs. While most of this Medium Priority TMDL involves implementation activities after 2005, some monitoring and assessment activities should be considered for funding during 2002-2005.

**Effectiveness:** Irrigation return flow controls are difficult to implement, although tailwater management has been practiced in Kansas for decades. The influence of upstream sulfate levels complicates the ability of the state to implement this TMDL. As such, the priority for this TMDL will remain Medium, as the state evaluates downstream benefits from irrigation return flow management in western Kansas and Colorado.

## 6. MONITORING

KDHE should collect bimonthly samples at Stations 584 and 284 over 2000-2010 in order to assess progress in implementing this TMDL over each of the three defined seasons during the initial implementation period. During the evaluation period (2005-2010), more targeted sampling may need to be conducted under all flow conditions in order to determine the achievement of the desired endpoints of this TMDL. Use of the real time flow data available at the Larned and Great Bend stream gaging stations can direct sampling efforts.

Monitoring of sulfate levels in effluent will be a condition of NPDES and state permits for facilities discharging to the Arkansas River or tributaries leading to the mainstem of the river.

## 7. FEEDBACK

**Public Meetings:** Public meetings to discuss TMDLs in the Upper Arkansas Basin were held March 8, 2000 and April 24, 2000 in Garden City. 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 Upper Arkansas Basin.

**Public Hearing:** A Public Hearing on the TMDLs of the Upper Arkansas Basin will be held in Garden City on May 31, 2000.

**Basin Advisory Committee:** The Upper Arkansas Basin Advisory Committee met to discuss the TMDLs in the basin on October 6, 1999; January 11 and 24, 2000; March 8, 2000;

**Discussion with Interest Groups:** Meetings to discuss TMDLs with interest groups include:  
Associated Ditches of Kansas: October 6, 1999; January 28, 2000; March 8, 2000; and April 24, 2000.  
Agriculture: February 28, 2000



Environmental: March 9, 2000

**Milestone Evaluation:** In 2005, evaluation will be made as to the degree of improvement in water quality in downstream reaches from activities occurring above Garden City. Subsequent decisions will be made on further implementation after 2005.

**Consideration for 303d Delisting:** The river will be evaluated for delisting under Section 303d, based on the monitoring data over the period 2005-2009. Therefore, the decision for delisting will come about in the preparation of the 2010 303d 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 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 under this TMDL will be considered in *Kansas Water Plan* implementation decisions under the State Water Planning Process after Fiscal Year 2005.

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